



EU R&D SCOREBOARD

The 2013 EU Industrial R&D
Investment Scoreboard

Acknowledgements

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IRMA activities aim to improve the understanding of industrial R&D and Innovation in the EU and to identify medium and long-term policy implications.

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Summary

The 2013 "EU Industrial R&D Investment Scoreboard" (the *Scoreboard*) contains economic and financial data for the world's top 2000 companies ranked by their investments in research and development (R&D). The sample contains 527 companies based in the EU and 1473 companies based elsewhere. The *Scoreboard* data are drawn from the latest available companies' accounts, i.e. usually the fiscal year 2012 or 2012/13¹.

Key messages

Trends observed show a significant variation in R&D investment and economic results across industries and sectors. This reflects persistent market uncertainties, in particular regarding the uneven potential for growth of international markets and the macroeconomic background. More salient facts observed from the analysis of 2012 and historic company data since 2003 include:

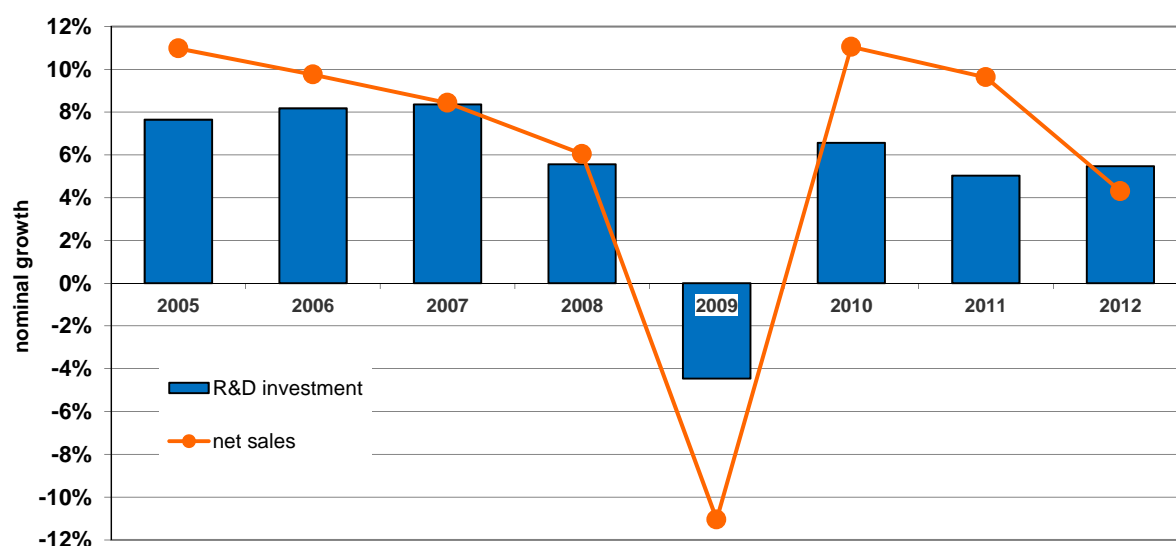
- A general remarkable resilience of R&D investment growth from top world R&D investors, in a period of economic uncertainty.
- The 527 EU companies featuring among the top world 2000 R&D investors in 2012 increased their investment in R&D by 6.3%, above world average (6.2%) but below the growth of their US counterparts (8.2%). EU overall positive numbers are largely driven by the R&D growth rates of German companies, particularly in the Automobile sector.
- Volkswagen with €9.5bn invested in R&D leads the world R&D ranking. In second place is Samsung Electronics (€8.3bn) from South Korea.
- In addition to a good performance in the Automobiles & Parts sector, EU-based companies outperformed the R&D growth of their US counterparts in Industrial Engineering (12.3% vs. 9.4%) and Aerospace & Defence (9.5% vs. -1.3%).
- The US continues to increase its specialisation in the high R&D-intensive sectors of ICT and health. Among the top 100 R&D investors, five ICT companies based in the US are among the best performers (increasing R&D and sales by more than 200% from 2004 to 2013). In the biotech sector, nine of the top ten companies are based in this country.
- An analysis of foreign direct investments (FDI) by the companies in the world R&D ranking shows that the EU plays, together with the US, a major role in the international investment scenario, both as a source and destination of cross-border R&D activities. From 2003 to 2012, the EU attracted 22% of FDI projects on R&D from the set of non-EU companies.

¹ However, due to differences in accounting practices, the sampling period includes a range of dates from 2011 to early 2013 (see annex on methodological notes).

Top world R&D investors continued to increase their investment efforts in research and development significantly (6.2%) in 2012. This happened in a global context marked by a general slow-down of net sales growth (4.2% vs. 9.9% in 2011) and a decline in operating profits (-10.1%).

During the three years following the financial crisis in 2008-2009, *Scoreboard* companies increased their R&D investments by an average 6.2% per year (2010-2012). This resilience of companies' R&D investments during a period of economic uncertainty reflects the strategic importance that companies attach to such investment. Figure S1 below shows the longer-term R&D trends for a subset of *Scoreboard* companies with available data for the past nine years.

Figure S1. One-year R&D investment and net sales growth in the *Scoreboard*.



Note: For 1496 out of the top world 2000 companies in the Scoreboard with data for the whole period.

*Source: The 2013 EU Industrial R&D Investment Scoreboard
European Commission, JRC/DG RTD.*

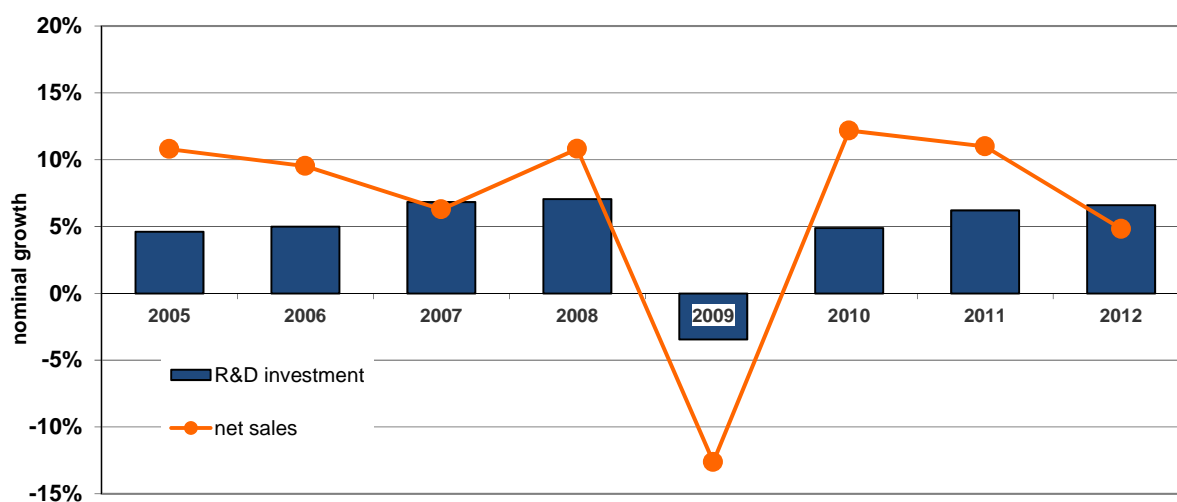
The 527 EU companies featuring among the top world 2000 R&D investors in 2012 are good exponents of sustained R&D focus in a challenging environment.

Their R&D growth rate of 6.3% in 2012 is above the 4.3% growth rate of net sales, in a context of sharp profit decreases (-18.4%). This R&D growth rate is lower than that of their US counterparts (8.2%), which experienced a stronger slow-down of net sales (2.9%).

Following a much slower recovery after the crisis, in 2012 top Japanese R&D investors showed some signs of recovery in net sales and profits, which are still not reflected in R&D growth figures (0.4%). Companies in the rest of the world continued to show high levels of R&D growth (8.8%).

For the EU, the US and Japan, respectively, figures S2-S4 below show the longer-term R&D trends for subsets of *Scoreboard* companies with available data for the past nine years.

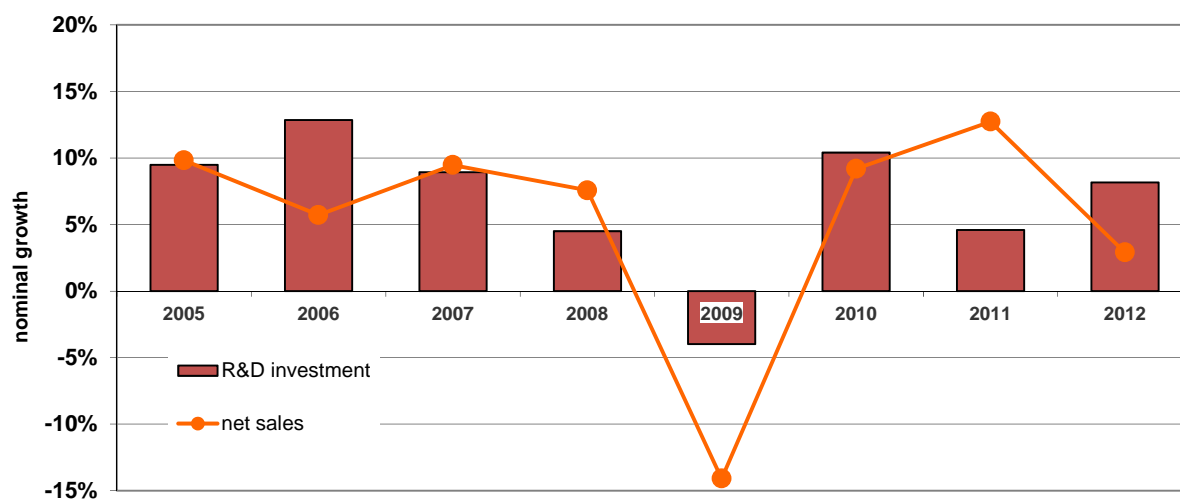
Figure S2. One-year R&D investment and net sales growth by EU companies.



Note: For 334 out of the top EU 527 companies in the Scoreboard with data for the whole period.

*Source: The 2013 EU Industrial R&D Investment Scoreboard
European Commission, JRC/DG RTD.*

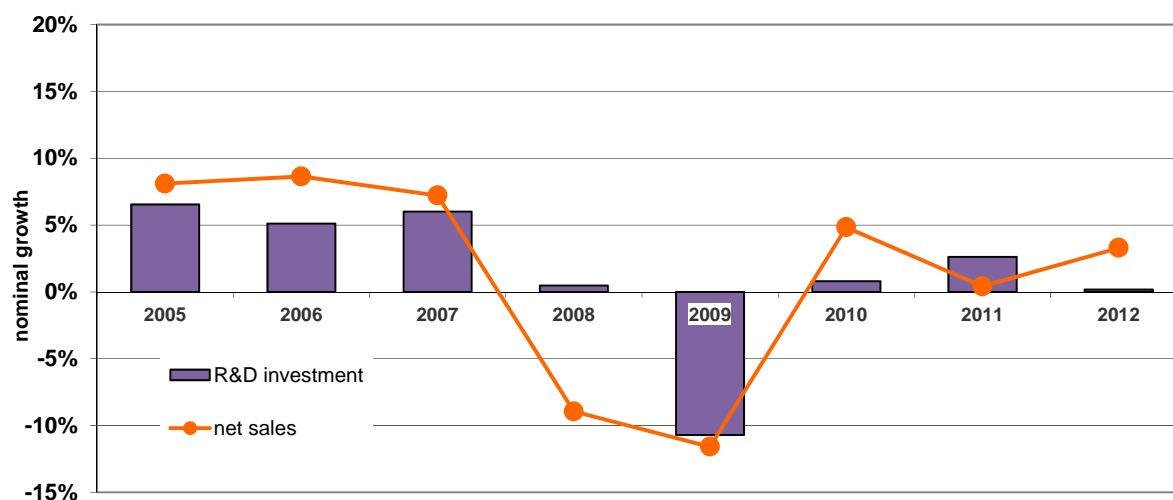
Figure S3. One-year R&D investment and net sales growth by US companies.



Note: For 547 out of the top US 658 companies in the Scoreboard with data for the whole period.

*Source: The 2013 EU Industrial R&D Investment Scoreboard
European Commission, JRC/DG RTD.*

Figure S4. One-year R&D investment and net sales growth by Japanese companies.



Note: For 324 out of the top Japanese 353 companies in the Scoreboard with data for the whole period.

*Source: The 2013 EU Industrial R&D Investment Scoreboard
European Commission, JRC/DG RTD.*

For the first time since 2004, a company based in the EU leads the world R&D ranking: The German carmaker Volkswagen, with €9.5bn invested in R&D. Samsung Electronics from South Korea jumps to the second place.

The other companies in the top ten include five from the US (three pharma and two ICT), two from Switzerland (both pharma) and one from Japan (automobile). Most of the 100 top companies showing the largest R&D increases continue to be, as in 2011, in the Automobiles & Parts and in the ICT sectors: e.g. Tata Motors, India (77.6%); Fiat, Italy (51.5%); 3M, the US (57.7%); Western Digital, the US (49.0%); Apple, the US (39.2%); Volkswagen, Germany (32.1%); Qualcomm, the US (30.7%), Huawei, China (30.3%), Google, the US (27.7%). Some of these companies have increased R&D partly as a result of acquisitions.

The top 50 companies of the *Scoreboard* are mainly from Automobiles & Parts, 12 (13 in 2004), ICT industries, 14 (13 in 2004) and Pharmaceuticals and Biotechnology, 15 (11 in 2004). These companies are based in the EU, 16 (18 in 2004), the US, 19 (17 in 2004) and Japan, 11 (same as in 2004).

Among the top 100 R&D investors, five ICT companies based in the US are among the best performers (in terms of R&D and sales growth) over the last ten years: Google (Internet), Oracle (Software), Qualcomm (Telecom equipment), Apple (Computer Hardware) and Broadcom (semiconductors).

The performance of EU companies compared to US companies in the ICT sectors varies by sub-sector...

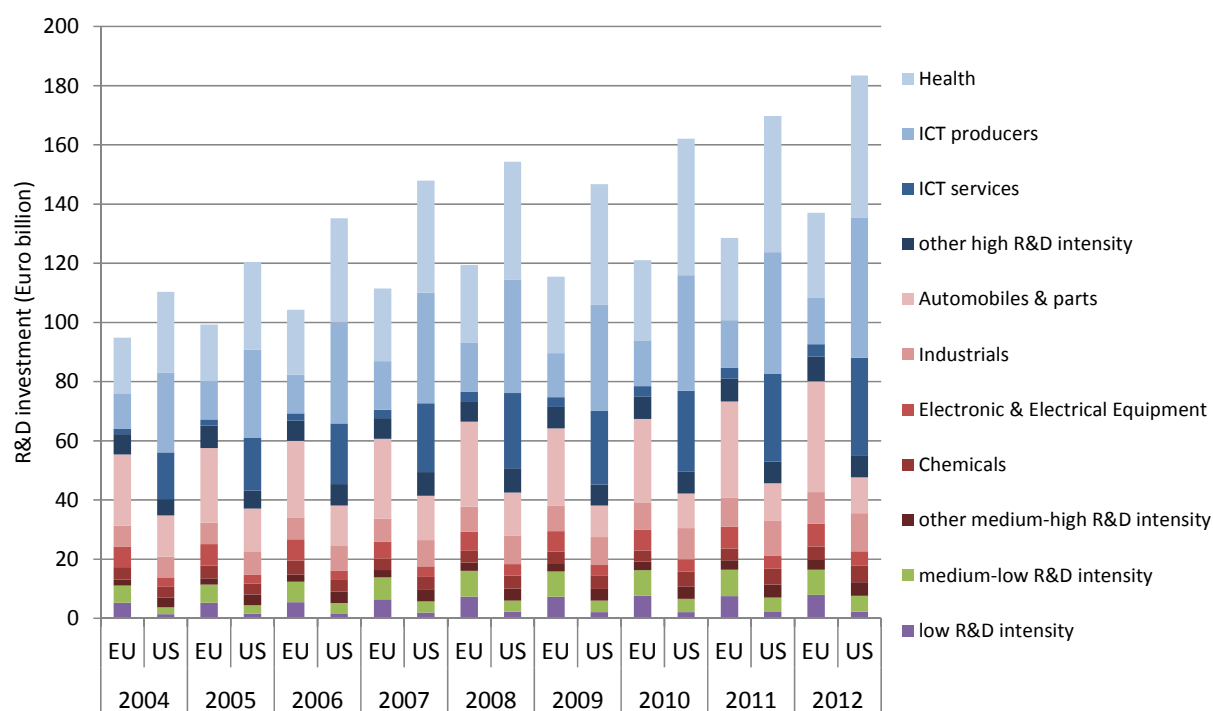
Despite lagging behind the US in the volume of R&D investments and in the number of companies, EU-based *Scoreboard* companies in the Software and Computer Services sector show very strong performance: 14.2% in R&D growth, coupled with 9.7% growth in sales (against 12.6% and 6.9% respectively for the US). This contrasts with negative figures in the Technology Hardware & Equipment sector for EU companies (-2.3% in R&D and -9.3% in sales); very positive developments (14.8% and 6.8% respectively) are observed for US ones.

... while in the Automobiles & Parts, Industrial Engineering and Aerospace & Defence sectors, EU-based companies clearly outperform their US counterparts.

EU companies in the Automobiles & Parts sector, led by German carmakers in particular, show very high increases in R&D investment and sales (14.2% and 11.3% respectively). The R&D growth rates of Volkswagen (32.1%), BMW (17.2%) and Robert Bosch (17%) determine a large portion of German and EU overall positive numbers. The opposite holds true for US-based Automobiles & Parts companies (-2.6% for R&D and 0% for sales growth), still recovering from the crisis and the US government bail-outs of GM and Chrysler (now owned by Fiat). In the case of the Aerospace & Defence sector, strong regional differences in performance are also observed in favour of the EU: increases of 9.5% in R&D and 8.3% in sales (against -1.3% and 6.7% respectively in the US).

The above-described divergent sectoral performances in the EU and US regions observed in 2012 point to a reinforcement of their relative specialisation: towards medium-high R&D-intensive sectors in the EU and towards high R&D-intensive sectors in the US (see figure S5).

Figure S5. R&D investment of EU and US companies by sector group.



Note: For 350 EU and 566 US out of the top world 2000 companies in the Scoreboard with data for the whole period.

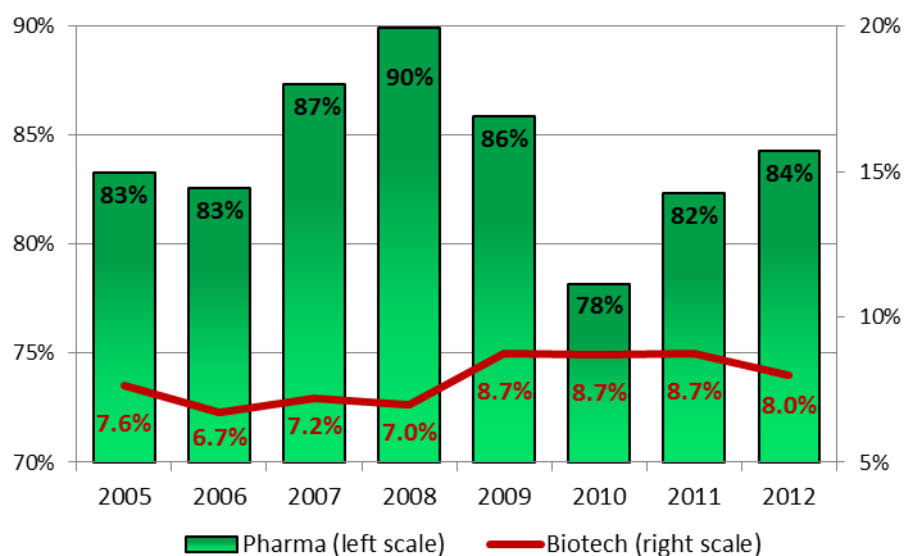
*Source: The 2013 EU Industrial R&D Investment Scoreboard
European Commission, JRC/DG RTD.*

Trends observed in the pharmaceutical and biotechnology subsectors illustrate well the reinforcement of the US specialisation towards high-tech intensive sectors.

While in 2012 the performance of the pharmaceutical and biotech sector in the US slowed down, showing the negative effect of the expiration of several of their blockbuster patents (4.3% in R&D but -0.3% in sales, compared with 3.2% and 2.8% respectively in the EU), the trend over the last ten years shows that the EU-US R&D investment gap in this sector is maintained (see figure S6).

A more detailed analysis of the therapeutic biotechnology subsector (expected to contribute with up to 50% of new drugs by 2018) shows the dominance of the US: eight of the top ten companies in terms of R&D growth and profitability are based in that country. However, evidence shows that there are a number of examples of EU companies which show both high performance and the ability to grow to a sustainable size through well-chosen collaborations, mainly with large pharmaceutical counterparts.

Figure S6. Relative size of EU R&D in Pharma and Biotech compared to US



Source: The 2013 EU Industrial R&D Investment Scoreboard European Commission, JRC/DG RTD.

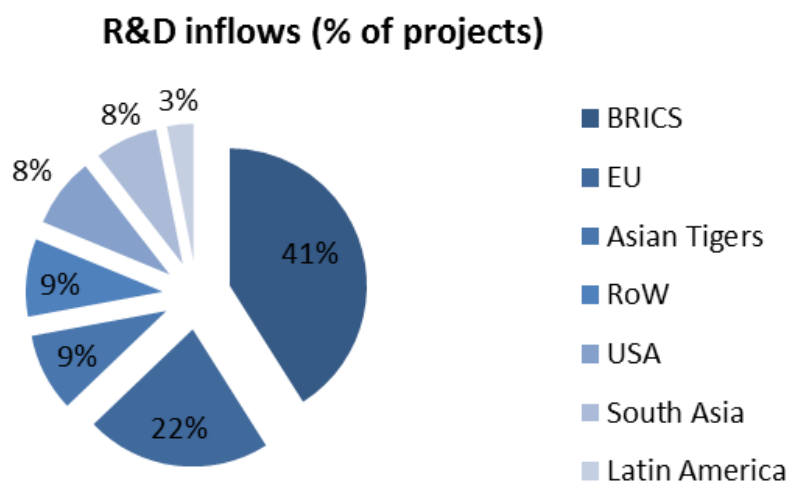
Note: The relative size has been calculated as the ratio of sector R&D expenditures in EU over US considering the 136 companies with R&D data for the whole period.

An analysis of foreign direct investments (FDI) by the companies in the world R&D ranking shows that the EU attracted 22% of FDI projects on R&D from the set of non-EU companies.

The EU, together with the US, plays a major role in the international investment scenario, both as a source and destination of knowledge-intensive FDIs. From 2003 to 2012, the EU attracted 22% of FDI projects on R&D from the set of non-EU companies while the US received only a share of 8 % (see figure S7). Six out of the ten countries with the highest number of international projects are European.

FDIs in R&D are concentrated mainly in 3 sectors: IT Hardware, Automobiles & Parts, and Pharmaceuticals & Biotechnology.

Figure S7. Inflows of FDIs in R&D by main world regions 2003-2012



Data: FT fDi Markets database.

Source: The 2013 EU Industrial R&D Investment Scoreboard European Commission, JRC/DG RTD.

Introduction

In 2013, we continued implementing changes in the “EU Industrial R&D Investment Scoreboard” (the *Scoreboard*)² aiming to enhance its capacity to monitor and analyse worldwide trends in industrial R&D. For background information on the *Scoreboard* please see Annex 1.

The scope of the *Scoreboard* has improved progressively, increasing the geographic and time coverage and the number of companies. The target is to cover fast-growing medium-sized companies, particularly those in key sectors such as health and the ICT-related industries.

Thus far, the total R&D investment of companies included in the *Scoreboard* is equivalent to more than 90% of the total expenditure on R&D by businesses worldwide³.

In this year's edition, the *Scoreboard* includes the **2000 companies investing the largest sums in R&D in the world** while maintaining an EU focus by complementing this coverage with the inclusion of the **top 1000 R&D investing companies based in the EU**⁴.

The *Scoreboard* collects key information to enable the R&D and economic performance of companies to be assessed. The main indicators, namely R&D investment, net sales, capital expenditures, operating profits and number of employees are collected following the same methodologies, definitions and assumptions applied in previous years. This ensures comparability so that the companies' economic and financial data can be analysed over a longer period of time.

For the second year, data are now being collected by [Bureau van Dijk Electronic Publishing GmbH](#), following basically the same approach and methodology applied since the first *Scoreboard* edition in 2004. Please see the main methodological limitations summarised in Box 1 and detailed methodological notes in Annex 2.

The capacity of data collection is being improved by gathering information about the ownership structure of the *Scoreboard* parent companies and the main indicators for their subsidiaries. This will allow a better characterisation of companies, in particular regarding the sectoral and geographic distribution of their research and production activities and the related patterns of growth and employment.

Companies' behaviour and performance can be analysed over longer time periods using our history database that contains information on the top R&D companies since 2003. This enables benchmarking analyses of companies across sectors and countries, for example the identification of companies showing outstanding economic or innovation results and the analysis of the main factors underlying such successful dynamics.

In this year's edition of the *Scoreboard*, companies' R&D rankings are based on information taken from the companies' latest published accounts. For most companies these correspond to calendar year 2012, but a significant proportion have financial years ending on 31 March 2013. There are few companies included with financial years ending as late as end June 2013 and a few for which only accounts to end 2011 were available.

² The EU Industrial R&D Investment Scoreboard is published annually by the European Commission (JRC-IPTS/DG RTD) as part of its Industrial Research and Innovation Monitoring and Analysis activity (IRIMA).

³ According to the latest figures reported by Eurostat, i.e. BERD financed by the business enterprise sector in 2009 compared with R&D figures in the 2010 Scoreboard.

⁴ In this report, the term EU company refers to companies whose ultimate parent has its registered office in a Member State of the EU. Likewise, non-EU company applies when the ultimate parent company is located outside the EU (see also the glossary and definitions in Annex 2 as well as the handling of parent companies and subsidiaries).

This report concentrates on the analysis of the world's top 2000 companies that all invested more than €22.6 million in R&D in 2012. The sample comprises companies based in the EU (527), the US (658), Japan (353) and other countries (462) including China, Taiwan, South Korea, Switzerland, the Cayman Islands, India, Canada, Australia, Israel, Norway, Bermuda, Brazil and a further 13 countries. A sample consisting of the top 1000 R&D investing companies based in the EU is analysed separately in chapter 4; these all have R&D investments exceeding €5.2 million.

The characteristics of the sample of 2000 companies used for most of the analysis are summarised in Table 1.

The sector and country composition of the EU 1000 sample is found in Annex 3.

This edition shows that companies continued to increase R&D investments in 2012 at a significant pace, higher than the growth rate of revenues. This report also shows a great variety in company R&D and economic patterns across industries and between countries, reflecting important differences in market conditions and economic background throughout the world.

Report structure

Chapter 1 presents the worldwide trends of industrial R&D. It provides an overview of the main indicators for the top 2000 companies ranked by level of R&D investment and the main changes that took place over the last year. An analysis of the main indicators of the company data aggregated by world regions is included together with the performance of companies over the period 2004-2012.

The performance of individual companies among the top R&D investors is provided in chapter 2. The list of the top world 100 R&D companies is examined highlighting those companies showing remarkable R&D and economic results and improvement in the R&D ranking over the last 10 years.

Chapter 3 presents an analysis of the main R&D and economic indicators of companies aggregated by industrial sector, with comparisons of EU companies and their main worldwide counterparts.

Chapter 4 discusses the trends on R&D and economic performance of the companies included in the extended sample comprising the top 1000 R&D investors based in Member States of the EU.

Chapter 5 focuses on the analysis of R&D-led trends on health and biotechnology and the behaviour of the main industrial players included in the *Scoreboard* over the past 10 years. The chapter includes the identification of most successful companies in this field and the comparison across countries and regions.

Finally, chapter 6 presents an analysis based on data about foreign direct investments (FDIs) made by the *Scoreboard* companies. It covers FDIs committed to R&D projects as well as to production facilities and other industrial activities. It includes a comparison of companies' FDI strategies across sectors and countries.

Annex 1 provides background and methodological information about how the *Scoreboard* is prepared. The methodological approach of the *Scoreboard*, its scope and the limitations are

described in Annex 2 and the listing of companies ranked by their level of R&D investment is provided in Annex 3.

The complete data set is freely accessible online at:

<http://iri.irc.ec.europa.eu/scoreboard13.html>

In the next edition, this website will allow user-friendly and interactive access to the individual company data or to groups of companies aggregated by industrial sector and country.

Table 1. Profile of the 2013 Scoreboard .***2000 companies with R&D investment above €22.6 million*****527 companies based in the EU**

Companies by country	Germany 130; United Kingdom 107; France 75; Sweden 40; Netherlands 35; Italy 30; Denmark 25; Finland 20; Spain 16; Belgium 13; Austria 12; Ireland 11; Luxembourg 4 ; Portugal 4 ; Czech Republic 1 ; Greece 1; Hungary 1; Malta 1; Slovakia 1
The 10 most numerous sectors	Industrial Engineering 62; Pharmaceuticals & Biotechnology 58; Electronic & Electrical Equipment 38; Software & Computer Services 37; Automobiles & Parts 36; Technology Hardware & Equipment 29; Chemicals 24; Banks 23; Health Care Equipment & Services 20; Aerospace & Defence 18. The top 5 sectors account for 43.8% of the 527.

1473 companies based in non-EU countries

Companies by country	US 658; Japan 353; China 93; Taiwan 82; South Korea 56; Switzerland 54; Cayman Islands 49; India 22; Canada 17; Australia 15; Israel 15; Norway 11; Bermuda 10; Brazil 8 and further 13 countries.
The 10 most numerous sectors	Technology Hardware & Equipment 264; Pharmaceuticals & Biotechnology 156; Software & Computer Services 151; Electronic & Electrical Equipment 139; Industrial Engineering 116; Chemicals 94; Automobiles & Parts 90; Health Care Equipment & Services 63; General Industrials 54; Construction & Materials 39. The top 5 sectors account for 56.1% of the 1473.

Source: *The 2013 EU Industrial R&D Investment Scoreboard.*
European Commission, JRC/DG RTD.

Box 1. Methodological caveats

Users of *Scoreboard* data should take into account the methodological limitations summarised here, especially when performing comparative analyses (full description of methodology is found in Annex 2):

A typical problem arises when comparing data from different currency areas. The *Scoreboard* data are nominal and expressed in Euros with all foreign currencies converted at the exchange rate of the year-end closing date (31.12.2012). The variation in the exchange rates from the previous year directly affects the ranking of companies, favouring those based in countries whose currency has appreciated with respect to the other currencies. In this reporting period, exchange rates of the Euro against main currencies changed less than in past years. The main currency move was due to the Japanese Yen that depreciated by 13.5% against the Euro, whereas the US dollar depreciated by less than 2.5% and the pound sterling remained practically unchanged.

The growth rate of the different indicators for companies operating in markets with different currencies is affected in a different manner. In fact, companies' consolidated accounts have to include the benefits and/or losses due to the appreciation and/or depreciation of their investments abroad. The result is an 'apparent' rate of growth of the given indicator that understates or overstates the actual rate of change. For example, this year the R&D growth rate of companies based in the Euro area with R&D investments in Japan is partly understated because the 'losses' of their overseas investments due to the appreciation of the Euro against the Japanese yen (from ¥100.6 to ¥114.2). Conversely, the R&D growth rate of Japanese companies is partly overstated due to the 'benefits' of their investments in the Euro area. Similar effects of understating or overstating figures would happen for other indicators, e.g. for net sales.

When analysing data aggregated by country or sector, be aware that in many cases, the aggregate indicator depends on the figures of a few firms. This is due, either to the country's or sector's small number of firms in the *Scoreboard* or to the indicator dominated by a few large firms.

The different editions of the *Scoreboard* are not directly comparable because of the year-on-year change in the composition of the sample of companies, i.e. due to newcomers and leavers. Every *Scoreboard* comprises data of several financial years allowing analysis of trends for the same sample of companies.

In most cases, the companies' accounts do not include information on the place where R&D is actually performed; consequently the approach taken in the *Scoreboard* is to attribute each company's total R&D investment to the country in which the company has its registered office. This should be borne in mind when interpreting the *Scoreboard*'s country classification and analyses.

Growth in R&D can either be organic, the outcome of acquisitions or a combination of the two. Consequently, mergers and acquisitions may sometimes underlie sudden changes in specific companies' R&D growth rates and/or positions in the rankings.

Other important factors to take into account include the difference in the various countries' (or sectors') business cycles which may have a significant impact on companies' investment decisions, and the initial adoption or stricter application of the International Financial Reporting Standards (IFRS)⁵.

⁵ Since 2005, the European Union requires all listed companies in the EU to prepare their consolidated financial statements according to IFRS (see: EC Regulation No 1606/2002 of the European Parliament and of the Council of 19 July 2002 on the application of international accounting standards at <http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:32002R1606:EN:HTML>).

1. Worldwide trends in corporate R&D

This chapter provides an overview of changes in the main R&D and economic indicators of the world 2000 companies that invested more than €22.6 million in R&D in 2012⁶. It comprises an analysis of the company data aggregated by main world region for the period 2004-2012.

This edition shows that companies continued to increase R&D investments in 2012 at a significant pace and well above the growth rate of revenues.

Trends observed show a significant variation of R&D investment and economic results across industries and sectors and important differences with respect to the previous year. This reflects persistent market uncertainties, in particular regarding the uneven potential for growth of international markets and the macroeconomic background.

Key findings

- The top 2000 *Scoreboard* companies invested in R&D 6.2% more in 2012 than in 2011, following the increase of 6.1% in the year before. The net sales of the 2000 companies increased less than R&D, at 4.2%, compared with the net sales increase of 9.9% in 2011.
- The 527 EU companies increased R&D investment and net sales by the significant figures of 6.3 % and 4.3 % respectively. The 658 US companies reported a higher increase in R&D (8.2 %) but a much lower increase in net sales (2.9 %). The Japanese companies continued to lag behind, the 353 companies based in Japan increased R&D by only 0.4% and net sales by 3.3%.
- Companies outside of the EU, the US and Japan (the OC group) continued to significantly increase R&D and net sales, by 8.8 % and 5.8 % respectively, but at a lower pace compared with previous years. The largest increases in R&D investment in this group were reported by companies based in China (12.2 %), South Korea (8.9 %) and Taiwan (8.2%).
- Trends over the past 8 years show that companies based in the EU and the US have recovered levels of R&D growth prior to the crisis whereas that of net sales, that recovered significantly in 2010-2011, fell well below the rate of R&D growth in 2012.

1.1 Indicator changes over the last year

The main economic and financial indicators for the year 2012 for the set of 2000 companies are summarised in Table 1.1.

- After the recovery of company results showed last year, this year's edition of the *Scoreboard* still shows a significant rise in worldwide R&D investment. The 2000 *Scoreboard* companies invested €538.8 billion in R&D, 6.2% more than in 2011,

⁶ Due to data availability some companies may be missed, please see methodological limitations in Annex 2.

following the increase of 6.1% in the year before. Seventy per cent of the companies showed positive R&D growth in 2012.

- For the second consecutive year, the net sales of the 2000 companies increased less than R&D, at 4.2%, less than the net sales increase of 9.9% in 2011. Company results in terms of operating profits were mixed, 82% of the companies made profits and average profitability was 9.2%, however the remaining companies (18%) presented strong losses.
- Company investment in fixed capital continued to grow at a significant pace. It increased by 9.6% compared with the previous year's increase of 12.7%. Capital expenditure as a percentage of net sales increased slightly from 6.6% in 2011 to 7.1% in 2012.

Table 1.1 Overall performance of the 2000 companies in the 2013 Scoreboard.	
<i>Factor</i>	<i>World-2000</i>
R&D investment, € bn	538.8
<i>One-year change, %</i>	6.2
<i>CAGR⁷ 3yr, %</i>	6.4
Net Sales, € bn	16845.8
<i>One-year change, %</i>	4.2
<i>CAGR 3yr, %</i>	8.5
R&D intensity, %	3.2
Operating profits, € bn	1549.3
<i>One-year change, %</i>	-10.1
<i>Profitability, %</i>	9.2
Capex ⁸ , € bn	1109.1
Capex / net sales, %	7.1
<i>One-year change, %</i>	9.6
Number of employees, million	48.471
<i>One-year change, %</i>	1.5
<i>Note: Calculation of growth rates and ratios include only companies for which data are fully available.</i> <i>Source: The 2013 EU Industrial R&D Investment Scoreboard.</i> <i>European Commission, JRC/DG RTD.</i>	

⁷ Compound annual growth rate.

⁸ Fixed capital investment

1.2 R&D trends by world region

This section analyses the overall R&D and economic performance of the *Scoreboard* companies according to the location of their registered offices in the main world regions. The 2000 companies are grouped into four main sets: the top 527 companies from the EU, 658 companies from the US, 353 from Japan and 462 companies from other countries (OC). 'Other countries' includes companies from China (93), Taiwan (82), South Korea (56), Switzerland (54), the Cayman Islands (49), India (22) and companies based in a further 19 countries.

Figure 1.1 and table 1.2 summarise the companies' indicators aggregated by main world region. Table 1.3 shows the main indicators for countries included in the OC group.

The R&D investment and net sales for the 527 EU companies continued to grow at significant pace in 2012, at 6.3 % and 4.3 % respectively (slightly above the world's average of 6.2 % and 4.2 % respectively).

The positive overall numbers of the EU group are largely driven by the performance of German companies, particularly in the Automobiles & Parts sector. The 130 German companies, with an R&D share of 34% in the EU group, increased R&D by 11.9% contributing more than 60% of the R&D growth of the EU companies.

The group of US companies increased R&D investment significantly above the world's average, at 8.2 % but net sales only grew by 2.9 % compared with a strong increase in 2011.

Japanese companies underperformed against EU firms, both in terms of R&D and net sales, increasing R&D investments and net sales only by 0.4% and 3.3% respectively.

Companies based outside of the EU, US and Japan (the OC group) substantially increased R&D and net sales, by 8.8 % and 5.8 % respectively, but in a lesser proportion than in previous years, especially in terms of net sales. The largest increase in R&D investment was reported by the 93 companies based in China (12.2 %), although the total R&D of these companies is still modest (3.0% of the total sample). Other companies in this group that showed large increases in R&D were companies based in the Cayman Islands (38.7%), India (33.1%), South Korea (8.9%) and Taiwan (8.2%). The companies based in Switzerland, the largest R&D investing country of the OC group (world R&D share of 4.2%) increased R&D in 2012 by 4.3%. Two large Swiss companies, Roche and Novartis, dominate the R&D figures of their home country with 62% of Swiss R&D.

Compared with last year's *Scoreboard* (1500 top R&D investors), the EU companies' share of total R&D investment rose by 1.2 (from 28.3 % to 29.5 %). The share held by US companies increased slightly by 0.5 percentage points, companies based in other countries (OC) increased their share by 1.2 percentage points, while the share of Japanese companies fell sharply by 2.9 points.

The average R&D intensity of the EU, US and OC companies increased due to a higher growth of R&D investments compared with the growth rate of net sales, especially for the US companies that had the lowest growth rate of net sales. On the contrary, companies based in Japan decreased their average R&D intensity because of their very low growth rate of R&D compared to that of net sales.

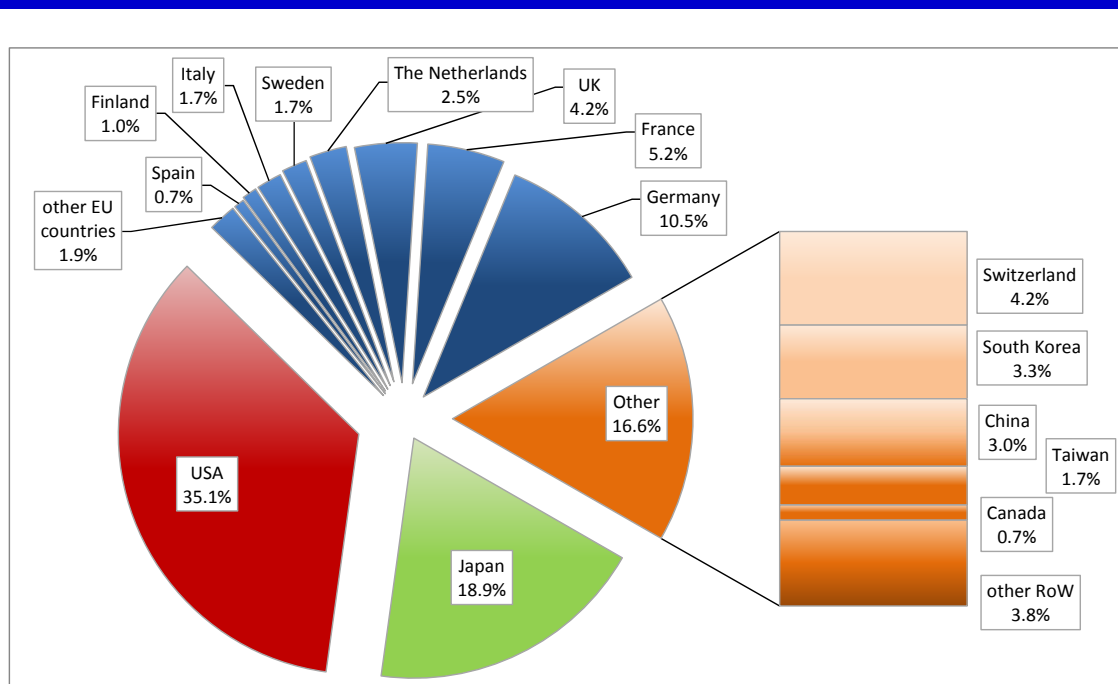
Company figures for fixed capital expenditure changed significantly over the last year. Companies based in the EU recovered substantial levels of investment (9.8% growth)

compared with a slight decrease in the previous year. The US and Japanese companies substantially increased their fixed capital expenditures to 11.7 % and 13.9 % respectively, whereas that of companies from the OC group increased at a more modest rate (5.7 %).

Companies in three of the four regions decreased profits in 2012 with Japanese companies showing a 4.2% increase but the EU had the largest decrease. As a consequence of this, the profitability (operating profits as percentage of net sales) remained level for Japan, decreased a little for the US but decreased a lot for the EU (the effect of a low growth rate of net sales can be offset by a lower growth rate of profits). In the case of the US group of companies, the drop in profits partially reflects the major losses of General Motors, which has just emerged from bankruptcy. In fact, this year's accounts for General Motors include a "goodwill impairment charge" of \$27bn and related losses of \$30.4bn.

As underlined in previous editions, most of the differences in R&D intensity and profitability between regions and countries are related to differences in sector mix. The US is by far the strongest region in the group of high R&D intensity sectors including pharmaceuticals, health, software, and technology hardware whereas the EU and Japan are stronger in medium R&D intensity sectors like the automotive sector (see chapter 4).

Figure 1.1 R&D investment by the top 2000 companies, by main world region (% of total €38.8bn)



Source: The 2013 EU Industrial R&D Investment Scoreboard
European Commission, JRC/DG RTD.

Table 1.2 Overall performance of the 2000 companies in the 2013 Scoreboard.

<i>Factor</i>	<i>EU</i>	<i>USA</i>	<i>Japan</i>	<i>Other countries</i>
No. of companies	527	658	353	462
R&D in 2012, € bn	158.0	189.4	102.7	89.4
World R&D share, %	29.3	35.2	18.9	16.6
<i>One year change, %</i>	6.3	8.2	0.4	8.8
<i>CAGR 3yr, %</i>	6.4	8.0	1.2	9.4
Net Sales, € bn	5974.6	3892.2	2944.0	4039.9
<i>One year change, %</i>	4.3	2.9	3.3	5.8
<i>CAGR 3yr, %</i>	8.6	8.4	3.0	13.0
R&D intensity, %	2.6	4.9	3.5	2.2
Operating Profit, € bn	483.4	505.7	131.1	429.0
<i>One year change, %</i>	-18.4	-5.5	4.2	-8.9
Profitability ⁹	8.1	13.0	4.4	10.6
Capex, € bn	361.90	231.3	195.2	320.7
Capex intensity	7.1	6.0	6.6	8.8
<i>One year change, %</i>	9.8	11.7	13.9	5.7
<i>Employees, million</i>	18.357	11.138	8.206	10.770
<i>One year change, %</i>	1.1	3.0	1.3	1.0

Source: The 2013 EU Industrial R&D Investment Scoreboard.

European Commission, JRC/DG RTD.

⁹ Operating profits as percentage of sales.

Table 1.3 Overall performance of companies based in the largest countries of the OC (other countries) group in terms R&D.

Factor	Switzerland	South Korea	China	Taiwan	OC group
No. of companies	54	57	93	82	462
R&D in 2012, € bn	22.4	17.5	16.1	9.3	89.4
World R&D share	4.2	3.3	3.0	1.7	16.6
One year change, %	4.3	8.9	12.2	8.2	8.8
CAGR 3yr, %	0.8	7.5	22.9	8.9	9.4
R&D intensity	6.4	2.2	1.4	2.2	2.2
Profitability	15.4	6.6	6.6	3.4	10.6
Employees, thousand	1375.8	1.6*	4152.2	2112.0	10770.0
One year change, %	5.1	-77.3*	-0.4	-1.8	1.0

* Many South Korean companies do not report number of employees.

Source: The 2013 EU Industrial R&D Investment Scoreboard.

European Commission, JRC/DG RTD.

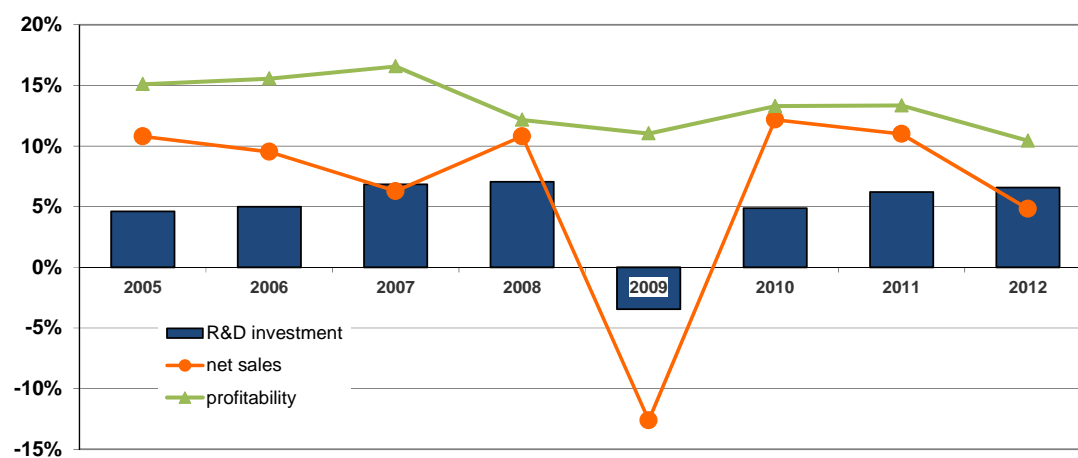
1.2.1 Long-term performance of companies by world region

The annual growth rates of R&D investment and net sales and the profitability of companies based in the EU, the US and Japan is provided respectively in figures 1.2, 1.3 and 1.4 for the period 2004-2012. These figures are based on our history database comprising R&D and economic indicators over the whole 2004-2012 period for 1017 companies (EU 248, US 358 and Japan 241).

The trends observed in these figures show the behaviour of these companies including the effects of the crisis that began in 2008. The following points are observed:

- In terms of R&D growth, companies based in the EU and the US seem to have recovered to the levels prior to the crisis, whereas Japanese companies lag behind, probably because of special adverse factors such as the earthquake.
- The growth rate of net sales for companies based in the EU and the US was hit hard by the crisis in 2008-2009 but recovered strongly in 2010-2011 with EU companies outperforming US firms in 2012. Net sales of companies from Japan were somewhat less affected by the crisis in 2008-2009 but have shown a slow recovery in the past two years.
- Performance in terms of profitability show that US-based companies recover more rapidly from the crisis and have higher levels of profitability than their EU counterparts and are especially higher than the Japanese ones.

Figure 1.2. One-year R&D investment and net sales growth and profitability by the EU companies.



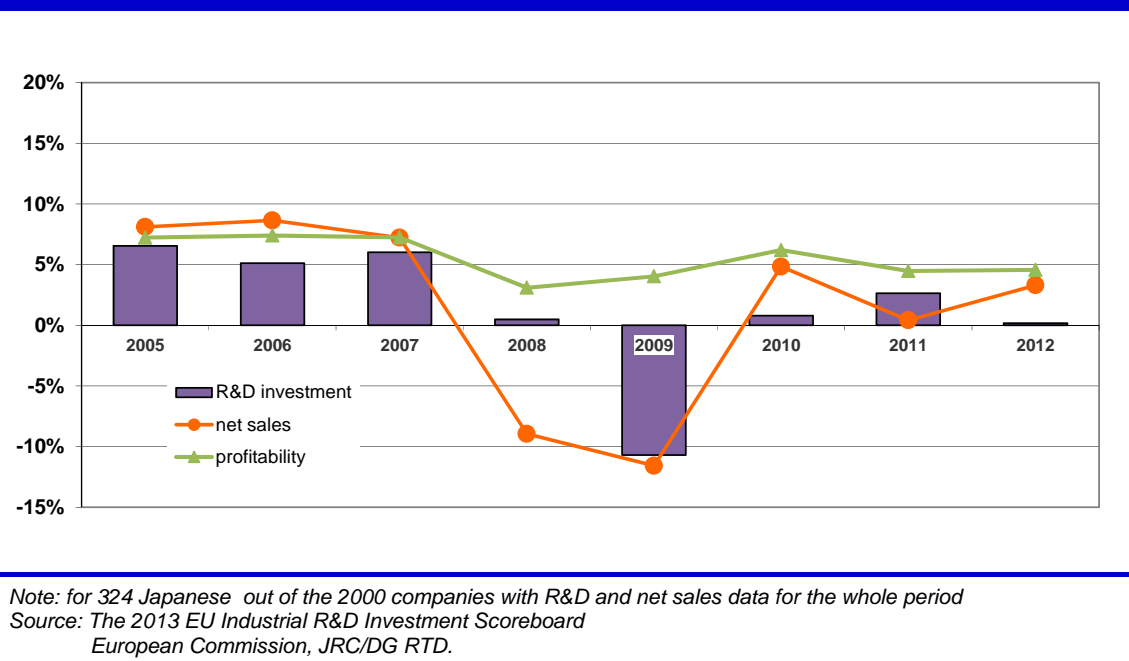
Note: for 388 EU out of the 2000 companies with R&D and net sales data for the whole period
Source: The 2013 EU Industrial R&D Investment Scoreboard
European Commission, JRC/DG RTD.

Figure 1.3. One-year R&D investment and net sales growth and profitability by the US companies.



Note: for 547 US out of the 2000 companies with R&D and net sales data for the whole period
Source: The 2013 EU Industrial R&D Investment Scoreboard
European Commission, JRC/DG RTD.

Figure 1.4. One-year R&D investment and net sales growth and profitability by the Japanese companies.



1.2.2 R&D trends by world regions and sector groups

Trends in R&D over the long-term are presented in figure 1.5 for the main world regions. The figures refer to a set of companies that reported R&D over the whole period 2004-2012 (1559 companies: EU 352, US 564, Japan 332 and rest of the world 311). The R&D data are broken down into groups of industrial sectors with characteristic R&D intensities (see definition in Box 1.1).

The following points can be observed regarding the overall R&D changes in the period 2004-2012 (figure 1.6):

- The world 1559 companies increased R&D by 50.8% (EU-352 44.4%; US-564 66.2%; Japan-332 11.6% and rest of the world-311 124.8%).
- For the 352 EU companies, the main R&D increases were in low R&D-intensive sectors (50.3%) and medium-low sectors (46.6%).
- For the 564 US companies, the main R&D increases were in medium-low R&D-intensive sectors (125.7%) and high sectors (79.7%).
- For the 332 Japanese companies, the main R&D increases were in medium-high R&D-intensive sectors (12.8%) and high sectors (12.3%).
- For the 311 companies based in the rest of the world, the main R&D increases were in low R&D-intensive sectors (276.7%) and high sectors (129.1%).

Box 1.1. Grouping of industrial sectors according to R&D intensity (R&D as % of net sales)

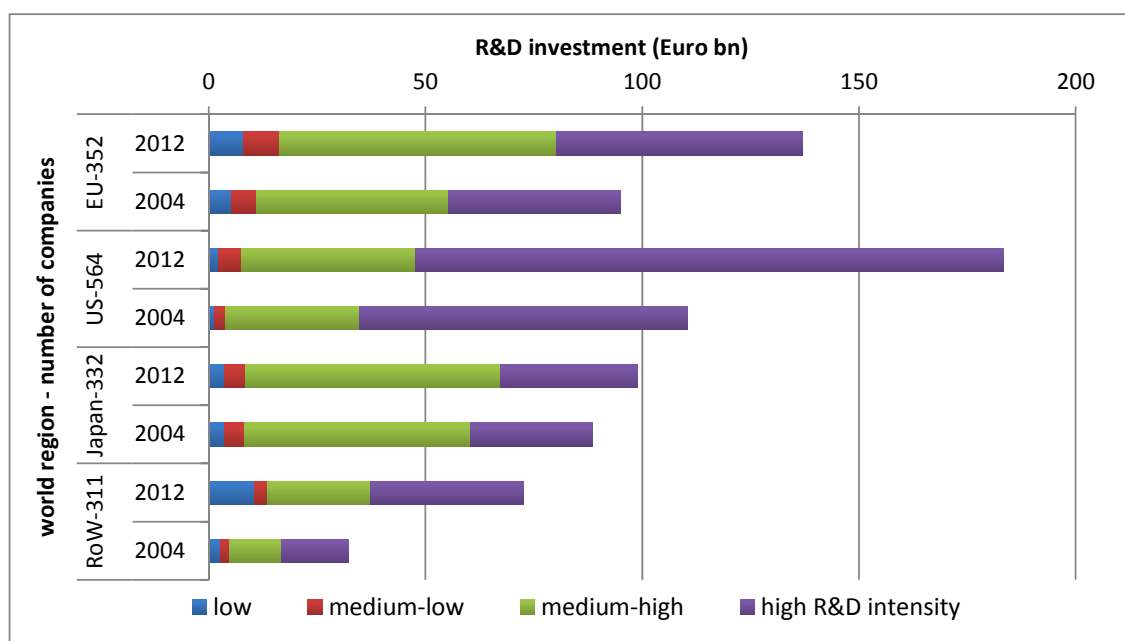
High R&D intensity sectors (intensity above 5%) include e.g. Pharmaceuticals & biotechnology; Health care equipment & services; Technology hardware & equipment; Software & computer services and Aerospace & defence.

Medium-high R&D intensity sectors (between 2% and 5%) include e.g. Electronics & electrical equipment; Automobiles & parts; Industrial engineering & machinery; Chemicals; Personal goods; Household goods; General industrials; Support services.

Medium-low R&D intensity sectors (between 1% and 2%) include e.g. Food producers; Beverages; Travel & leisure; Media; Oil equipment; Electricity; Fixed line telecommunications.

Low R&D intensity sectors (less than 1%) include e.g. Oil & gas producers; Industrial metals; Construction & materials; Food & drug retailers; Transportation; Mining; Tobacco; Multi-utilities.

Figure 1.5 R&D investment trends by the Scoreboard companies for main world regions



Note: For companies that reported R&D for the whole period 2004-12 (EU-352, US-564, Japan-332 and Rest of the World-311).

Source: The 2013 EU Industrial R&D Investment Scoreboard
European Commission, JRC/DG RTD.

1.2.3 Employment trends by regions and sector groups

The companies listed in this year's *Scoreboard* employed 48.471 million people in 2012, 1.5% more than the previous year. The distribution of employees by region was 18.357 million in the 527 companies based in the EU, 11.138 million in the 658 US companies, 8.206 million in the 353 Japanese companies and 10.770 million in the 462 companies from other countries (1827 out of the 2000 companies reported number of employees).

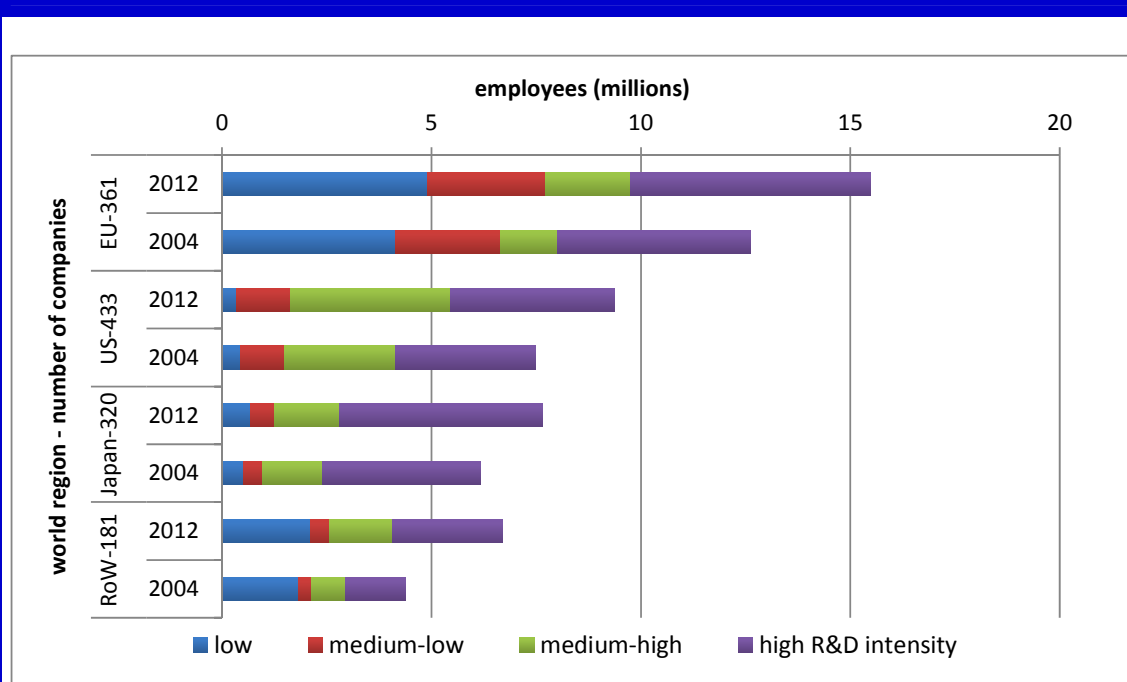
Trends on employment over the long-term are presented in figure 1.6 for the main world regions. The figures refer to a set of companies that reported number of employees over the whole period 2004-2012 and are broken down into groups of industrial sectors with characteristic R&D intensities (see definition in Box 1.1).

The following points can be observed regarding the changes in number of employees in the period 2004-2012 (figure 1.6):

- Overall worldwide employment increased by 27.9 % from 2004 to 2012 led by increases in high R&D-intensive sectors (42.0 %) and medium-high sectors (29.9 %).
- For the EU companies, the overall employment growth was 22.6 %, increasing by 49.2 % in high R&D-intensive sectors, by 24.2% in medium-high and by 18.5% in low sectors.
- For the US companies, the overall employment growth (25.1 %) greatly varies by sector group: a strong increase for high R&D-intensive sectors (43.7 %) and a sharp decrease in low-tech sectors (-23.2 %).
- For the Japanese companies, the overall employment increase of 24.0 % corresponded to an increase of 31.4 % in low R&D-intensive sectors and of 28.5 % in medium-high sectors.
- The ratio of employment in high to medium-high R&D intensity sectors for companies based in Japan fell from 38% to 32%, rose slightly for EU companies, from 29% to 35%, and went up a lot for US companies from 80% to 98%. This illustrates the way high R&D-intensive sectors in the US have been growing rapidly while medium-high sectors such as the automotive sector are slowly going down the rankings.

It is important to remember that data reported by the *Scoreboard* companies do not inform about the actual geographic distribution of the number of employees. A detailed geographic analysis should take into account the location of subsidiaries of the parent *Scoreboard* companies as well as the location of other production activities involved in the value-chains.

Figure 1.6 Employment trends by the *Scoreboard* companies for main world regions.



Note: For 1295 out of the EU, US, and Japanese companies and those from the Rest of the World that reported employment data for the whole period 2004-12.

*Source: The 2013 EU Industrial R&D Investment Scoreboard
European Commission, JRC/DG RTD.*

2. Top R&D investing companies

This chapter describes the performance of individual companies, with a focus on the results of top R&D investors, highlighting those companies that show considerable changes in economic performance, in particular from an R&D viewpoint.

The world's top 100 R&D companies are analysed, highlighting those presenting important changes from the previous year and those showing the best performance in terms of R&D and economic growth over the last 10 years. This year's R&D ranking of the top 50 companies is presented in figure 2.1 and table 2.1 shows changes in such ranking since the first *Scoreboard* in 2004.

Key findings

- The top R&D investor is the German company Volkswagen, which was in 3rd place last year and in 6th place the year before. In 2nd position is Samsung Electronics from South Korea with Microsoft from the US 3rd. The other companies in the top-ten include four from the US, two from Switzerland and one from Japan.
- Results of the top 100 companies, accounting for 54.6 % of the total R&D investment by the 2000 companies, confirm the continued recovery of industrial R&D investment. Of these 100 companies, 72 increased R&D investment (vs. 75 in 2011), including 30 companies with double-digit R&D growth; of the 28 that decreased R&D, 7 decreased by a double digit percentage. Regarding net sales, 64 companies reported an increase (vs. 71 in 2011), including 25 companies with double-digit sales growth.
- The top 100 group includes:
 - 28 EU companies of which 19 have increased R&D (10 by more than 10%),
 - 37 US companies of which 31 increased R&D (11 by more than 10%),
 - 22 from Japan of which 10 increased R&D (4 by more than 10%) and
 - 14 companies from other countries of which 12 increased R&D (5 by more than 10%).
- The companies showing the largest increase in R&D are Tata Motors, India (77.6%); 3M, US (57.7%); FIAT, Italy (51.5%); Western Digital, US (49.0%); Gilead Sciences, US (46.4%). Those showing the largest decrease in R&D are Renesas, Japan (-24.9%); Hitachi, Japan (-17.3%); Boeing, US (-17.1%); Nokia, Finland (-15.1%); Pfizer, US (-14.0%).
- Among the top 100 group, 30 companies have at least doubled their net sales since 2004 (8 companies based in the EU and 13 from the US). This group of companies is mainly from high R&D-intensive sectors (18); 27 of them have increased R&D by more than 100% and 15 companies increased employment by more than 100%. A number of the large increases are for companies that have made substantial acquisitions.

General trends

In the 2013 *Scoreboard* 111 companies have an R&D investment of more than € 1.0bn (31 from the EU and 40 from the US) while 55 have R&D exceeding € 2.0bn (18 from the EU and 21 from the US).

The top 10 companies invested more than € 5bn in R&D and account for 13.3 % of the total R&D investment by the 2000 *Scoreboard* companies.

This year, the top R&D investor is the German company Volkswagen (€ 9.5bn) which was third last year and sixth in 2010¹⁰. There are five US companies in the top ten: Microsoft (€7.9bn), Intel (€7.7bn), Merck US (€6.0bn), Johnson & Johnson (€5.8bn) and Pfizer (€5.7bn). The other companies in the top ten are Roche (€ 7.0bn) and Novartis (€ 6.9bn) from Switzerland, Samsung Electronics (€8.3bn) from South Korea and Toyota Motor (€7.1bn) from Japan.

The top 100 companies invested € 295.4 billion, accounting for 54.6 % of the total R&D investment by all the 2000 *Scoreboard* companies, although accounting for only 27.1% of the total net sales of the sample. The EU has 28 companies among the top 100 R&D investors, one company less than it had in the 2012 *Scoreboard*. The US has 36 companies, two more than it had last year and Japan has 22, three companies less than in last year's *Scoreboard*.

The EU companies in the top 100 are mainly from the Automobiles & Parts (8), Pharmaceuticals & Biotechnology (7) and ICT sectors (5). The US companies are mainly from the ICT (13), Pharmaceuticals & Biotechnology (10), and Chemicals (3) sectors. The Japanese companies operate mainly in the Automobiles & Parts (5), ICT (4) and Pharmaceuticals (4) sectors.

Seventy-one companies in the top 100 have shown positive R&D investment growth. Among them, 30 companies had double-digit R&D growth, and of these, 17 companies also showed double-digit growth in net sales.

Most of the top 100 companies showing the largest R&D increases are in the Automobiles & Parts sector, e.g. Tata Motors, India (77.6%); Fiat, Italy (51.5%); Volkswagen, Germany (32.1%); BMW, Germany (17.2%), Bosch, Germany (16.1%) and in ICT sectors, e.g. 3M, US (57.7%); Western Digital, US (49.0%); Apple, US (39.2%); Qualcomm, US (30.7%), Huawei, China (30.3%), Google, US (27.7%).

Other companies among the top 100 group have shown double-digit growth in both R&D and net sales, e.g. Gilead Sciences and EBay from the US; SAP from Germany; Novo Nordisk from Denmark; Samsung Electronics from South Korea.

Twenty-eight companies in the top 100 have experienced a decrease in R&D investing. Among these, three companies decreased R&D investments and net sales by more than 10 %: Renesas, Japan; Nokia, Finland and Vale, Brazil.

The R&D intensity of companies in the top 100 (6.4%) has increased slightly due to a higher rate of increase for R&D (6.2 %) than for net sales (5.7 %). The EU companies in the top 100 have a higher average R&D intensity (6.9 %) than that of non-EU companies (6.2 %).

¹⁰ This year, the figures of VOLKSWAGEN include those of its new subsidiary PORSCHE that in 2011 reported €1046 of R&D investment. This amount of R&D accounts approximately for 50 % of the VOLKSWAGEN's increase of R&D in 2012.

R&D changes driven by Mergers and Acquisitions (M&As)

The growth in R&D investment may either be organic or driven by M&As, or it may be a combination of the two. M&As (or demergers) may take place within or between regions/sectors and can significantly impact the ranking of companies in the *Scoreboard*. While acquisitions are not systematically captured in this report, some examples that had a significant effect on companies in the top positions are provided in table 2.1 below.

Table 2.1. Merger and acquisition activity involving *Scoreboard* companies

Acquiror	Deal value €m	Target name	Vendor	Completed date	Deal type
JOHNSON & JOHNSON	14353.2	SYNTHES INC.	SHAREHOLDERS	14/06/2012	Acq. 100%
GOOGLE	9758.0	MOTOROLA MOBILITY	SHAREHOLDERS	22/05/2012	Acq. 100%
NESTLÉ SA	9125.7	PFIZER INC.'S INFANT NUTRITION	PFIZER INC.	30/11/2012	Acq. 100%
MICROSOFT	6164.2	SKYPE GLOBAL SARL	SILVER LAKE PARTNERS	13/10/2011	Acq. 100%
BRISTOL-MYERS SQUIBB	5647.6	AMYLIN PHARMACEUTICALS INC.	SHAREHOLDERS	08/08/2012	Acq. 100%
VOLKSWAGEN	4490.0	PORSCHE AG	PORSCHE AUTOMOBIL	01/08/2012	Acq. from 49.9% to 100%
CISCO SYSTEMS	4070.5	NDS GROUP LTD	NEWS CORPORATION	31/07/2012	Acq. 100%
GENERAL ELECTRIC	3234.6	AVIO SPA'S AVIATION	BCV INVESTMENTS SCA	01/08/2013	Acq. 100%
GENERAL ELECTRIC	2535.9	LUFKIN INDUSTRIES INC.		01/07/2013	Acq. 100%
GLAXOSMITHKLINE	2463.7	HUMAN GENOME SCIENCES INC.	TAUBE HODSON STONEX PARTNERS	03/08/2012	Acq. 100% - Bid 2 - offer
VOLKSWAGEN	2083.4	MAN AG		09/11/2011	Acq. from 30.47% to 53.71%
SIEMENS	2057.9	INVENSYS RAIL GROUP	INVENSYS PLC	02/05/2013	Acq. 100%
BRISTOL-MYERS SQUIBB	1888.5	INHIBITEX INC.		13/02/2012	Acq. 100%
NOKIA	1700.0	NOKIA SIEMENS	SIEMENS	07/08/2013	Acq. from 50% to 100%
IBM	1559.0	SOFTLAYER	GLOBAL INNOVATION	08/07/2013	Acq. 100%
ORACLE	1452.7	TALEO CORPORATION		11/04/2012	Acq. 100%
ORACLE	1151.0	RIGHTNOW		25/01/2012	Acq. 100%
DENSO	1136.0	RENESAS ELECTRONICS		30/09/2013	Acq. 74.979%
TOSHIBA	1096.2	WESTINGHOUSE ELECTRIC	NUCLEAR ENERGY	04/01/2013	Acq. from 67% to 87%
SONY	1063.1	M3 INC.	SO-NET	11/01/2013	Acq. 55.8%
SONY	1050.0	SONY ERICSSON MOBILE	TELEFONAKTIEBOLET	31/01/2012	Acq. from 50% to 100%
ERICSSON	904.9	TELCORDIA	WARBURG PINCUS LLC	12/01/2012	Acq. 100%
GOOGLE	777.0	WAZE INC.	KLEINER PERKINS	11/06/2013	Acq. 100%
DAIMLER	767.0	BEIJING FOTON DAIMLER		18/02/2012	Joint venture 100%
SONY	535.5	SO-NET ENTERTAINMENT		20/09/2012	Acq. from 57.974% to 95.609%
HUAWEI	398.4	HUAWEI SYMANTEC	SYMANTEC	30/03/2012	Acq. from 51% to 100%
IBM	275.9	ALGORITHMICS INC.	FITCH INC.	21/10/2011	Acq. 100%
AMGEN	251.6	KAI PHARMACEUTICALS	THOMAS WEISEL	05/07/2012	Acq. 100%
GLAXOSMITHKLINE	250.0	OKAIROS AG	NOVARTIS VENTURE	29/05/2013	Acq. 100%
SAMSUNG ELECTRONICS	239.9	CSR PLC'S DEVELOPMENT	CSR PLC	04/10/2012	Acq. 100%
VOLKSWAGEN	139.5	MAN SE		05/06/2012	Acq. from 73.76% to 75.03%
INTEL	105.8	CRAY INC.'S HIGH-	CRAY INC.	02/05/2012	Acq. 100%

Source : Zephir database by Bureau van Dijk.

Long-term performance of top R&D companies

This section analyses the behaviour of the top companies over the last 10 years based on our history database containing company data for the period 2002-2012. Results of companies showing outstanding R&D and economic results are underlined.

Ranking of the top 50

Table 2.2 shows the evolution of the R&D rankings of the top 50 companies since the first *Scoreboard* in 2004 and the most important changes are highlighted. It is important to note, as stated in the previous section and in past reports, that the growth of companies is often accompanied by mergers and acquisitions.

There are 16 EU companies (18 in 2004) and 34 non-EU companies (32 in 2004). In the EU group, three companies left the top 50 (Philips, Renault and BAE Systems) and one company joined the top 50 (Boehringer Ingelheim). In the non-EU group, eight companies left the top 50 (Fujitsu, Matsushita Electric, NEC, Motorola, Nortel Networks, Wyeth, Delphi, Sun Microsystems) and ten companies joined the top 50 (Abbott, Amgen, Apple, Denso, Google, Huawei, Oracle, Panasonic, Qualcomm and Takeda Pharmaceuticals).

The distribution of the top 50 companies by main industrial sector and region changed from 2004 to 2012 as follows:

- Automobiles & Parts, from 13 (EU 7) to 12 (EU 6)
- ICT industries, from 13 (EU 3) to 14 (EU 3)
- Pharma & Biotech, from 11 (EU 3) to 15 (EU 5)

The EU companies that improved by at least 10 places are Boehringer Ingelheim (now ranked 41st) and Sanofi (now 15th). The latter was created after 2004 and is an example of R&D growth driven by M&As.

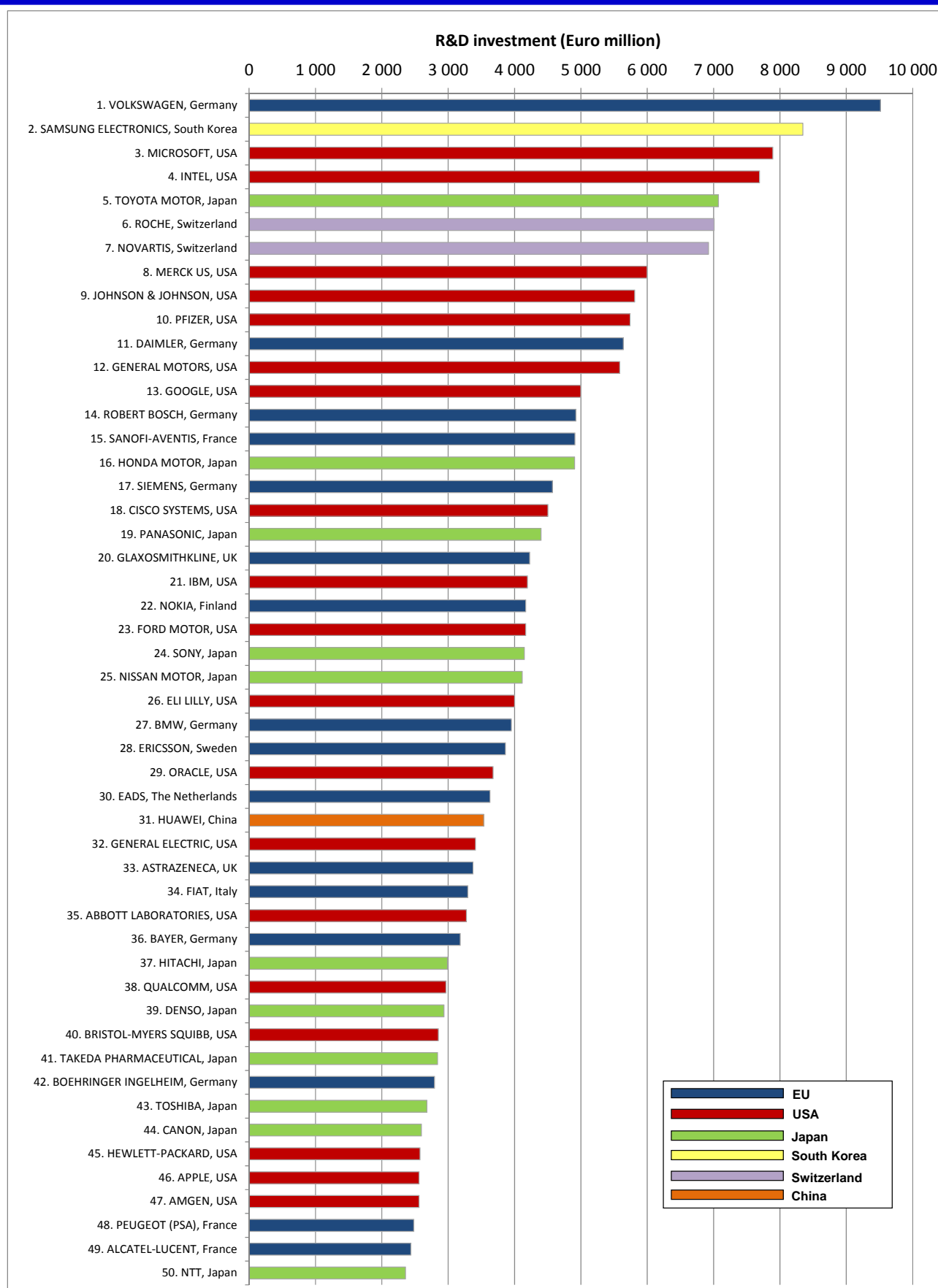
There are 15 non-EU companies that gained more than 10 places. They include Google, up more than 200 (now 13th), Panasonic, up 128 (now 19th), Qualcomm, up 87 (now 37th), Huawei, up more than 200 (now 31st), Oracle, up 40 (now 29th).

Companies which dropped ten or more places but remained within the top 50 include Siemens (now 17th), IBM (now 21st), Ford Motor (now 23rd), Ericsson (now 28th), NTT (now 49th), Hewlett-Packard (now 44th), and Nokia (now 22nd).

Best performers among the top 100

Among the top 100 group, 14 companies have simultaneously increased R&D and net sales by more than 200% since 2004 while showing positive operating profits in the last reporting period. Nine of these companies are based in the US, two in China and one each in Taiwan, India and Brazil (see table 2.3).

Figure 2.1. The world's top 50 companies by their total R&D investment (€m) in the 2013 Scoreboard.



Source: The 2013 EU Industrial R&D Investment Scoreboard.

European Commission, JRC/DG RTD.

Table 2.2 R&D ranking of the top 50 companies in the 2004 and 2013 Scoreboards.

Rank in 2012	Company	Rank change 2004-2012
1	VOLKSWAGEN	up 7
2	SAMSUNG ELECTRONICS	up 31
3	MICROSOFT	up 10
4	INTEL	up 10
5	TOYOTA MOTOR	dow n 1
6	ROCHE	up 11
7	NOVARTIS	up 13
8	MERCK US	up 21
9	JOHNSON & JOHNSON	up 3
10	PFIZER	dow n 8
11	DAIMLER	dow n 8
12	GENERAL MOTORS	dow n 6
13	GOOGLE	up > 200
14	ROBERT BOSCH	up 12
15	SANOFI	up 40
16	HONDA MOTOR	nil
17	SIEMENS	dow n 13
18	CISCO SYSTEMS	up 13
19	PANASONIC	up 128
20	GLAXOSMITHKLINE	dow n 9
21	IBM	dow n 12
22	NOKIA	dow n 12
23	FORD MOTOR	dow n 22
24	SONY	dow n 9
25	NISSAN MOTOR	up 9
26	ELI LILLY	up 15
27	BMW	up 1
28	ERICSSON	dow n 11
29	ORACLE	up 42
30	EADS	up 5
31	HUAWEI	up > 200
32	GENERAL ELECTRIC	up 5
33	ASTRAZENECA	dow n 8
34	FIAT	up 10
35	ABBOT LABORATORIES	up 17
36	BAYER	dow n 4
37	HITACHI	dow n 13
38	QUALCOMM	up 99
39	DENSO	up 13
40	BRISTOL-MYERS SQUIBB	up 2
41	TAKEDA PHARMACEUTICAL	up 31
42	BOEHRINGER INGELHEIM	up 20
43	TOSHIBA	dow n 13
44	CANON	dow n 5
45	HEWLETT-PACKARD	dow n 22
46	APPLE	up 109
47	AMGEN	up 9
48	PEUGEOT (PSA)	dow n 10
49	ALCATEL-LUCENT	dow n 32
50	NTT	dow n 29

Note : Companies in "blue" went up more than 20 ranks and companies in "red" lost more than 20 ranks.

Source: The EU Industrial R&D Investment Scoreboards 2013 and 2004.

Table 2.3. Ranking of companies among the top 100 R&D investors that achieved the best performance over the last 10 years*.

<i>rank</i>	<i>Company</i>	<i>Country</i>	<i>Sector</i>	<i>R&D in 2012 (€ m)</i>
1	GOOGLE	USA	Internet	4997.0
2	ORACLE	USA	Software	3675.9
3	QUALCOMM	USA	Telecommunications Equipment	2967.3
4	APPLE	USA	Computer Hardware	2562.5
5	BROADCOM	USA	Semiconductors	1756.9
6	PETROCHINA	China	Oil & Gas Producers	1741.6
7	TATA MOTORS	India	Automobiles & Parts	1496.0
8	EBAY	USA	General Retailers	1408.2
9	GILEAD SCIENCES	USA	Biotechnology	1333.9
10	CELGENE	USA	Biotechnology	1205.8
11	HON HAI PRECISION IND.	Taiwan	Electronic Equipment	1191.6
12	WESTERN DIGITAL	USA	Computer Hardware	1191.5
13	ZTE	China	Telecommunications Equipment	1170.5
14	VALE	Brazil	Mining	1120.2

** These companies increased simultaneously R&D investment and net sales by more than 200 % from 2004 to 2012 and had positive operating profits in 2012.*

Source: The 2013 EU Industrial R&D Investment Scoreboard.

European Commission, JRC/DG RTD.

3. R&D distribution by industrial sector

This chapter presents the main R&D trends among *Scoreboard* companies aggregated by industrial sectors¹¹. It comprises the ranking of sectors by their level of R&D investment, R&D intensities, rates of R&D growth and the comparison of such trends across world regions.

Key findings

- Companies from three out of the top five sectors by level of R&D investment increased R&D above the world average of 6.2%, namely Software & Computer Services (11.7%), Automobiles & Parts (8.9%) and Technology Hardware & Equipment (8.8%). The top R&D investing sector, Pharmaceuticals and Biotechnology achieved a more modest 4.1% increase of R&D. Other sectors that showed high R&D growth were the Industrial Engineering (9.8%) and Health Care Equipment & Services (8.3%) sectors.
- Companies based in the EU had the highest R&D growth in Automobile & Parts (14.4%), Software & Computer Services (14.2%) and the Industrial Engineering (12.3%) sectors.
- Trends observed in the *Scoreboard* over the last 10 years show a characteristic sector specialisation by region. The largest R&D shares of the companies based in the EU are in Automobiles & Parts (24.9%), Pharmaceuticals & Biotechnology (17.5%) and Technology Hardware & Equipment (10.2%). The main R&D shares of those based in the US specialise in high R&D-intensive sectors, namely Technology Hardware & Equipment (25.2%), Pharmaceuticals & Biotechnology (22.1%) and Software & Computer Services (18.2%). These three high R&D-intensity sectors account for 65.5% of US R&D, 30% for the EU and 26% for Japan.

General R&D trends

Figure 3.1 shows the R&D rankings of companies from the main industrial sectors including the relative R&D share by main world region. The specialisation of the main world regions, represented by the share of sectors within the regions' total R&D investment, is given in figure 3.2.

- R&D investment in the *Scoreboard* remains highly concentrated by sectors: Out of 40 industrial sectors, the top three –Pharmaceuticals & Biotechnology, Technology Hardware & Equipment and Automobiles & Parts– account for 50.2% of the total R&D investment by the *Scoreboard* companies; the top 6 and top 15 sectors constitute, respectively, 71.0% and 92.1% of the total R&D in the *Scoreboard*. A similar concentration of R&D by industrial sector has been observed over the last 10 years.

¹¹ According to the Industry Classification Benchmark (ICB) applied in the *Scoreboard*.

- The ranking of the top 15 sectors has changed as follows: The Industrial Engineering sector took over the 6th position from the Chemicals sector (now 7th), the General Industrials sector took the 9th position from the Leisure Goods (now 10th).
- The Pharmaceuticals & Biotechnology sector keeps the first position in the R&D ranking, slightly increasing its R&D share of the total R&D investment which is now 18.1%. It is followed by the Technology Hardware & Equipment sector with a share of 16.4% (similar to last year's 16.6%) and the Automobile & Parts sector with 15.7%, slightly higher than the 15.0% of last year.
- The R&D specialisation (share of R&D investment) of the main regions in the top 3 sectors are:

In the EU, Automobiles & Parts (24.9%), Pharmaceuticals & Biotechnology (17.5%), and Technology Hardware & Equipment (10.2%);

In the US, Technology Hardware & Equipment (25.2%), Pharmaceuticals & Biotechnology (22.1%) and Automobiles & Parts (6.6%);

In Japan, Automobiles & Parts (26.4%), Pharmaceuticals & Biotechnology (10.8%) and Technology Hardware & Equipment (7.3%).
- The contribution to the total *Scoreboard* R&D by EU companies is 53.0% to Aerospace & Defence, 46.1% to Automobiles & Parts and 39.5% to the Industrial Engineering sectors; the US contributes 74.4% to Software and Computer Services, 63.8% to Health Care Equipment & Services and 54.0% to Technology Hardware & Equipment and; Japan contributes 34.5% to Chemicals, 33.3% to the Electronic & Electric Equipment sector and 31.8% to Automobiles & Parts.

R&D growth by industrial sector

The actual contribution of an industrial sector to the overall R&D growth of a region depends on its rate of R&D change and the sector's share of total R&D of the region. Figures 3.1 and 3.2 show the shares of the main industrial sectors and table 3.1 shows their ranking by R&D annual growth rate worldwide for the *Scoreboard* companies based in the main world regions (EU-527, US-658, and Japan-353).

The following points are observed for the top 15 sectors accounting for 92.1% of the total R&D investment of the *Scoreboard* companies:

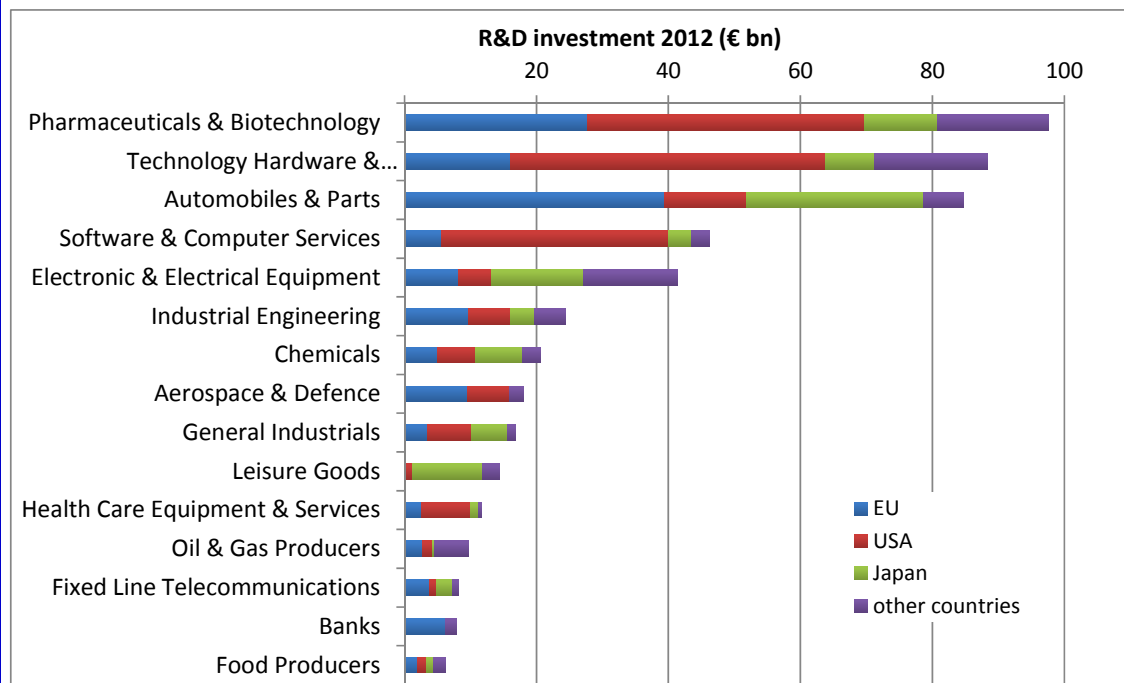
- Worldwide, the Software & Computer Services sector shows the highest one-year growth rate (11.8%), followed by Industrial Engineering (9.8%), Automobiles & Parts (8.9%) and Technology Hardware & Equipment (8.8%) sectors.
- Among the companies based in the EU, the Automobiles & Parts sector shows the highest one-year growth rate (14.4 %), followed by the Software & Computer Services (14.2 %) and Industrial Engineering (12.3 %) sectors. Sectors showing the lowest one-year R&D growth are Banks (for which only the EU companies report R&D, -6.8 %), Fixed Line Telecom (-4.6%), and Technology Hardware & Equipment (-2.3 %).

- Among the companies based in the US, the Technology Hardware & Equipment sector shows the highest one-year growth rate (14.8 %) followed by Software & Computer Services (12.6 %) and Industrial Engineering (9.4%). Sectors showing the lowest one-year R&D growth are Food Producers (-12.4 %) and Leisure Goods (-4.6 %).
- For Japanese companies, the highest one-year growth rate is shown by Automobiles & Parts (6.4 %) and Health Care Equipment & Services (4.9 %). The poorest performance was shown by General Industrials (-9.7 %) and Electronic & Electrical Equipment (-6.9 %).

Apart from the top 15 industries, there were important R&D changes in some other sectors:

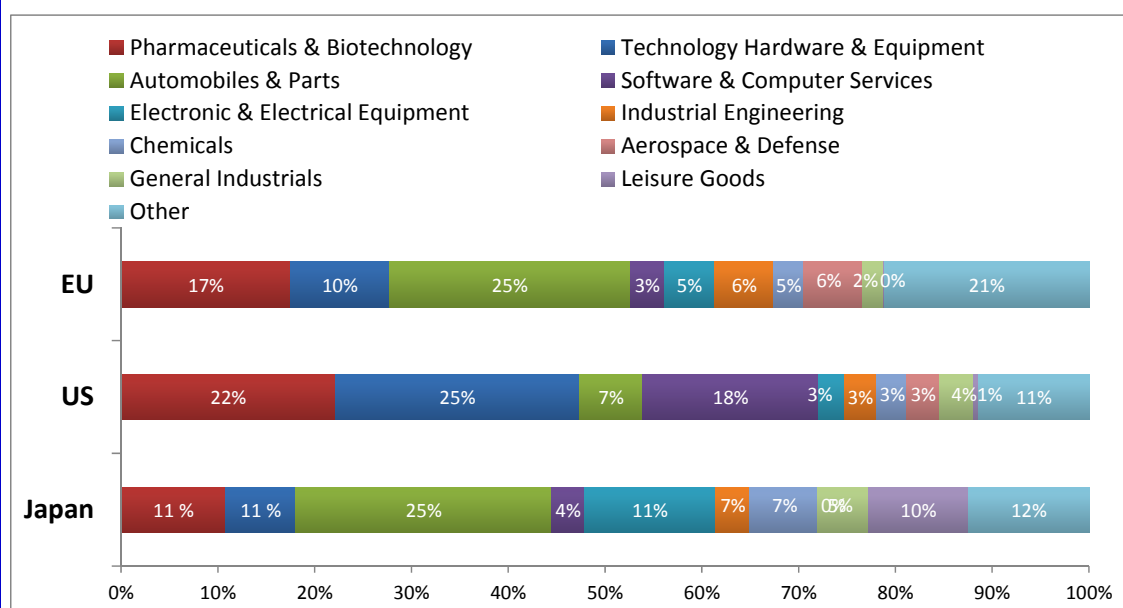
- The alternative energy sub-sector that has shown a substantial increase of R&D investment over the past years sharply reduced R&D in 2012 (-26.1 %).
- Other sectors showing considerable R&D growth are Food & Drug Retailers (48.0 %) and Industrial Transportation (30.3%).

Figure 3.1. R&D ranking of industrial sectors and share of main world regions for the world's top 2000 companies.



Source: The 2013 EU Industrial R&D Investment Scoreboard
European Commission, JRC/DG RTD.

Figure 3.2. R&D shares of sectors of the main world regions



Source: The 2013 EU Industrial R&D Investment Scoreboard
European Commission, JRC/DG RTD.

Table 3.1. Ranking of top 15 industrial sectors by overall one-year R&D growth for the EU, US and Japanese companies in the 2013 Scoreboard.

Rank	Sector	Overall one-year R&D growth (%)	EU-527 R&D change (%)		US-658 R&D change (%)		Japan-353 R&D change (%)	
			1 year	3 years	1 year	3 years	1 year	3 years
1	Software & Computer Services	11.8	14.2	10.0	12.6	10.4	-4.7	-8.4
2	Industrial Engineering	9.8	12.3	10.0	9.4	13.3	3.4	4.2
3	Automobiles & Parts	8.9	14.4	12.6	-2.6	5.1	6.4	5.3
4	Technology Hardware & Equipment	8.8	-2.3	1.4	14.8	9.7	-4.1	-0.5
5	Health Care Equipment & Services	8.3	8.7	7.6	8.5	6.2	4.9	3.9
6	Aerospace & Defence	7.0	9.5	6.1	-1.3	1.3		
7	Chemicals	6.9	8.6	3.8	7.0	8.4	0.7	0.9
8	Pharmaceuticals & Biotechnology	4.1	3.2	3.7	4.3	5.7	4.8	-0.1
9	Oil & Gas Producers	3.8	9.5	4.7	2.2	1.4	-4.9	9.8
10	Leisure Goods	2.9	1.7	2.5	-4.6	-2.6	2.5	2.2
11	Electronic & Electrical Equipment	2.5	4.4	4.2	6.1	8.2	-6.9	0.6
12	Food Producers	1.1	6.3	7.2	-12.4	1.8	0.0	1.6
13	Fixed Line Telecommunications	0.6	-4.6	-6.1	7.5	9.3	0.5	-1.1
14	General Industrials	0.2	5.6	4.7	7.2	10.2	-9.7	-3.2
15	Banks	-4.3	-6.8	13.4				
	Total 40 industries	6.2	6.3	6.6	8.2	8.0	0.4	1.2

Source: The 2013 EU Industrial R&D Investment Scoreboard.

European Commission, JRC/DG RTD

R&D intensity by sector

Table 3.2 provides the list of industrial sectors ranked by worldwide R&D intensity of the main industrial sectors for the 2000 *Scoreboard* companies grouped by main world region.

The following points are observed:

- Some industrial sectors increased their R&D intensity as R&D investment increased more than net sales in 2012, in particular the Technology Hardware & Equipment (8.8% vs. 1.9%) and the Industrial Engineering sector (9.8% vs. 3.5%). The opposite happened for the Electronic & Electric Equipment sector (2.4% vs 5.5%).
- Four sectors have an R&D intensity of more than 5.0%: Pharmaceuticals & Biotechnology, IT sectors (Software & Computer Services and Technology Hardware & Equipment) and Leisure Goods. The sector with the lowest R&D intensity is Oil & Gas Producers (0.3%).
- Among the top 15 sectors, the R&D intensity of EU companies is larger than that of the US and Japan in 6 sectors (Software & Computer Services, Technology Hardware & Equipment, Industrial Engineering, General Industrials and Automobiles & Parts and Aerospace & Defence) but the EU sector is much smaller than that of the US one for the first two of these sectors. Japanese companies show higher R&D intensity than the EU and the US in sectors such as Electronic & Electrical Equipment and Chemicals. The R&D intensity of US companies is higher than that of the EU and Japan in Pharmaceuticals & Biotechnology.
- As observed in previous *Scoreboards*, the overall lower average of R&D intensity of the EU companies is due to their large share of low R&D-intensive sectors as compared to a similar group of non-EU companies. Conversely, the high average R&D intensity of the US companies is due to their considerable weight in high R&D-intensive sectors (see Figures 3.1 and 3.2)

Table 3.2. Ranking of industrial sectors by overall R&D intensity for the EU, US and Japanese companies in the 2013 Scoreboard.					
Rank	Sector	Overall sector R&D intensity, %	EU-527 sector R&D intensity, %	US-658 sector R&D intensity, %	Japan-353 sector R&D intensity, %
1	Pharmaceuticals & Biotechnology	14.4	13.9	15.8	13.2
2	Software & Computer Services	9.9	12.6	11.5	4.8
3	Technology Hardware & Equipment	7.9	14.5	8.8	6.1
4	Leisure Goods	6.3	3.3	5.3	6.7
5	Aerospace & Defence	4.5	6.0	3.0	
6	Electronic & Electrical Equipment	4.3	4.8	4.3	5.2
7	Automobiles & Parts	4.2	5.1	3.7	4.3
8	Health Care Equipment & Services	4.1	3.6	3.9	6.9
9	Industrial Engineering	2.8	3.5	3.0	2.0
10	Chemicals	2.7	2.0	3.4	3.9
11	General Industrials	2.5	5.1	3.1	2.2
12	Banks	2.0	1.8		
13	Fixed Line Telecommunications	1.7	1.5	1.1	2.5
14	Food Producers	1.3	1.5	0.9	1.5
15	Oil & Gas Producers	0.3	0.3	0.3	0.2
	Total 40 industries	3.2	2.6	4.9	3.5
Source: The 2013 EU Industrial R&D Investment Scoreboard. European Commission, JRC/DG RTD					

Growth of net sales and profitability by industrial sector

Table 3.3 shows the ranking of the top 15 industrial sectors by overall one-year growth of net sales for the companies based in the EU, the US and Japan. It also includes the sector profitability for these regions.

The following points are observed:

- Worldwide, the Automobiles & Parts sector shows the highest one-year growth rate of net sales (8.8%), followed by Software & Computer Services (7.4%), Food Producers (7.3%) and Aerospace & Defence (6.4%). Regarding the automotive sales, it is worth noting a couple of points: First, the Japanese earthquake in 2011 meant that sales recovered strongly in 2012 as Toyota and others ramped production back up. Second, 2012 vehicle sales in units were up 5.2% but volume fell 5.9% in Europe with only Russia and the UK showing reasonable increases (figures from wardsauto.com). This means that the *Scoreboard* sales growth figures for European automotive companies suggest that they did well in exporting to the expanding markets of North America and Asia Pacific.
- Among the companies based in the EU, the highest growth rates of net sales are in Leisure Goods (16.3%), the Automobiles & Parts sector (11.3%) and Food Producers (10.1%). The sector showing the lowest one-year sales growth is Technology Hardware & Equipment (-9.3%). Among the largest sectors in the EU, the highest profitability is shown in Pharmaceuticals & Biotechnology (19.0%) and Software & Computer Services (18.2%). The EU companies' negative profitability of the Technology Hardware & Equipment sector (-1.1%) is mostly due to large losses incurred by Nokia, STMicroelectronics and Alcatel-Lucent.
- Among the companies based in the US, the Software & Computer Services sector shows the highest one-year growth rate for sales (6.9%) followed by Technology Hardware & Equipment (6.8%). Sectors showing the lowest one-year R&D growth are Leisure Goods (-2.7%) and Oil & Gas Producers (-3.0%). The US-based companies have the highest profitability in Software & Computer Services (23.9%) and Pharmaceuticals & Biotechnology (21.7%). The US companies' negative profitability of the Automobiles & Parts sector (-3.2%) to a large extent reflects the major losses of General Motors. The negative sales growth rate in Pharmaceuticals & Biotechnology (-0.3%) reflects patent expiries for Pfizer, BMS and Abbott.
- For Japanese companies, the highest one-year growth rate is shown by Automobiles & Parts (11.9%) and Pharmaceuticals & Biotechnology (3.5%). The poorest performance is shown by the Health Care Equipment & Services sector (-1.7%). The profitability of companies based in Japan is generally lower than their counterparts in the EU and the US, for example 8.9% in Pharmaceuticals & Biotechnology vs. 19.0% for the EU companies.

Table 3.3. Ranking of top 15 industrial sectors by overall one-year sales growth for the EU, US and Japanese companies in the 2013 Scoreboard.

Rank	Sector	World-wide	EU-527		US-658		Japan-353	
		Sales growth 1y (%)	Sales growth 1y (%)	Profit.*	Sales growth 1y (%)	Profit.*	Sales growth 1y (%)	Profit.*
1	Automobiles & Parts	8.8	11.3	5.2	0.0	-3.2	11.9	5.6
2	Software & Computer Services	7.4	9.7	18.2	6.9	23.9	-0.2	2.8
3	Food Producers	7.3	10.1	10.7	3.8	10.4	1.6	3.5
4	Aerospace & Defence	6.4	8.3	7.0	6.7	9.0		
5	Electronic & Electrical Equipment	5.5	5.0	9.1	1.2	13.1	-1.3	3.2
6	Oil & Gas Producers	3.7	2.8	9.4	-3.0	16.7	2.3	1.8
7	Health Care Equipment & Services	3.5	8.7	15.4	2.1	8.5	-1.7	7.6
8	Industrial Engineering	3.5	4.1	8.4	6.4	11.6	2.6	5.0
9	Chemicals	2.2	3.0	9.9	3.7	10.8	-1.5	4.4
10	Technology Hardware & Equipment	1.9	-9.3	-1.1	6.8	14.9	-1.2	6.6
11	Pharmaceuticals & Biotechnology	1.9	2.8	19.0	-0.3	21.7	3.5	8.9
12	General Industrials	1.5	6.9	6.4	4.7	11.6	-0.2	4.2
13	Fixed Line Telecommunications	0.5	-1.1	8.7	0.7	10.1	1.8	11.5
14	Banks	-1.1	-1.8	6.8				
15	Leisure Goods	-1.4	16.3	21.0	-2.7	9.1	-0.5	3.6
	Total 40 industries	4.2	4.3	8.1	2.9	13.0	3.3	4.4

* Profitability: operating profits as percentage of net sales.

Source: The 2013 EU Industrial R&D Investment Scoreboard.
European Commission, JRC/DG RTD

Changes in indicators by region and sector groups

It is interesting to see the distribution of R&D investment of the *Scoreboard* companies across regions and sectors using an aggregation of the 40 industrial sectors into four groups of high-, medium-high-, medium-low- and low- R&D intensity (see Box 1.1 in chapter 1).

The worldwide and domestic distribution of the R&D investment by the 2000 *Scoreboard* companies shows clear differences by world region, illustrating respectively the weight of the region in the world and its specialisation (See Table 3.4):

- Companies based in the EU specialise in medium-high R&D-intensive sectors (44.5% of total R&D of the EU companies) and contribute 34.8% of the total world R&D of that sector group. Two sectors, Automobiles & Parts and Industrial Engineering, account for almost 70% of the total R&D investment of the EU's medium-high R&D intensity group.
- Those based in the US specialise in high R&D intensive sectors (73.3% of total R&D of the US companies) and contribute 50.3 % of the world R&D of that sector group. Three sectors, Pharmaceuticals & Biotechnology, Technology Hardware & Equipment and Software & Computer Services, account for almost 90% of the total R&D investment of the US's high R&D intensity group.
- Japanese companies specialise in medium-high R&D intensive sectors (58.2%) while contributing 29.4% of world R&D of that sector group. Two sectors, Automobiles & Parts and Electronics & Electric Equipment, account for 68.6% of Japan's medium-high R&D intensity group.

Table 3.4. World and domestic R&D distribution of the 2000 *Scoreboard* companies by sector groups for the main regions.

Sector	High		Medium-high		Medium-low		Low		
Region	Share, %		Share, %		Share, %		Share, %		Total
	world	domestic	world	domestic	world	domestic	world	domestic	domestic
EU	22.3	39.0	34.8	44.5	40.4	6.4	45.1	10.1	100
US	50.3	73.3	20.7	22.1	25.2	3.3	7.0	1.3	100
Japan	12.2	33.0	29.4	58.2	19.8	4.9	11.4	3.9	100
Other countries	15.2	47.0	15.2	34.4	14.7	4.1	36.5	14.5	100
Total world	100		100		100		100		

Note : Sector groups as defined in Box 4.1.

Source: The 2013 EU Industrial R&D Investment Scoreboard.
European Commission, JRC/DG RTD

4. The top 1000 R&D investors in the EU

This chapter discusses the R&D and economic trends of companies based in Members States of the EU. This specific analysis is based on an extended sample of companies representing the top 1000 R&D investors in the EU, i.e. the 527 EU companies included in the world top 2000 sample and 473 additional companies based in the EU. The main questions addressed are firstly about the one-year changes in R&D and economic indicators of companies based in the top 10 Member States by level of R&D investment. The second question regards the long-term trends of company results, namely the rate of growth of R&D and net sales and profitability for companies based in the top three Member States of the EU.

Key findings

- Companies based in Germany, the top R&D investor, continued with the good performance shown in the past year, increasing R&D in 2012 to well above the world average, at 11.6 %. On the contrary, companies based in the UK and France showed a poor performance, increasing R&D by 0.5% and 2.3% respectively.
- Among the group of the 10 largest EU countries, those whose companies increased R&D above the EU average were Italy (18.3 %), Ireland (10.7 %), the Netherlands (7.7 %) and Sweden (6.7 %). Companies based in three countries decreased R&D in 2012: Finland (-10.3 %), Denmark (-3.0 %) and Spain (-2.1 %). These three countries have their total R&D dominated by that of only a few companies, e.g. Nokia accounting for nearly 74% of Finland's R&D in the *Scoreboard*.
- The analysis of 10-year trends of R&D and economic results for companies based in Germany, the UK and France show the effects of the crisis in 2008-2009 and the strong recovery over 2010-2012 for the German companies.

Overview of the EU 1000 companies

The composition of the sample of the EU 1000 companies across industrial sectors and countries is found in Annex 3. This sample, as well as the global 2000, shows a high concentration of companies by sector and country. The 6 largest sectors in terms of R&D account for 50% of the companies. These sectors and the countries accounting for at least 15% of the companies each are:

• Software & Computer Services	113	:	UK 47, France 21, Germany 19
• Pharmaceuticals & Biotechnology	112	:	UK 30, France 18
• Industrial Engineering	112	:	Germany 42
• Electronic & Electrical Equipment	73	:	Germany 16, UK 15, France 12
• Automobiles & Parts	50	:	Germany 20, UK 11, France 6
• Technology Hardware & Equipment	46	:	UK 11, Germany 7, Sweden 7

A look at the lower reaches of the EU top 1000 companies

Table 4.1 below compares the sector composition of the upper (EU companies which belong to the World top 2000 companies) and lower reaches of the top 1000 EU *Scoreboard* companies across the 6 largest sectors in terms of R&D investments.

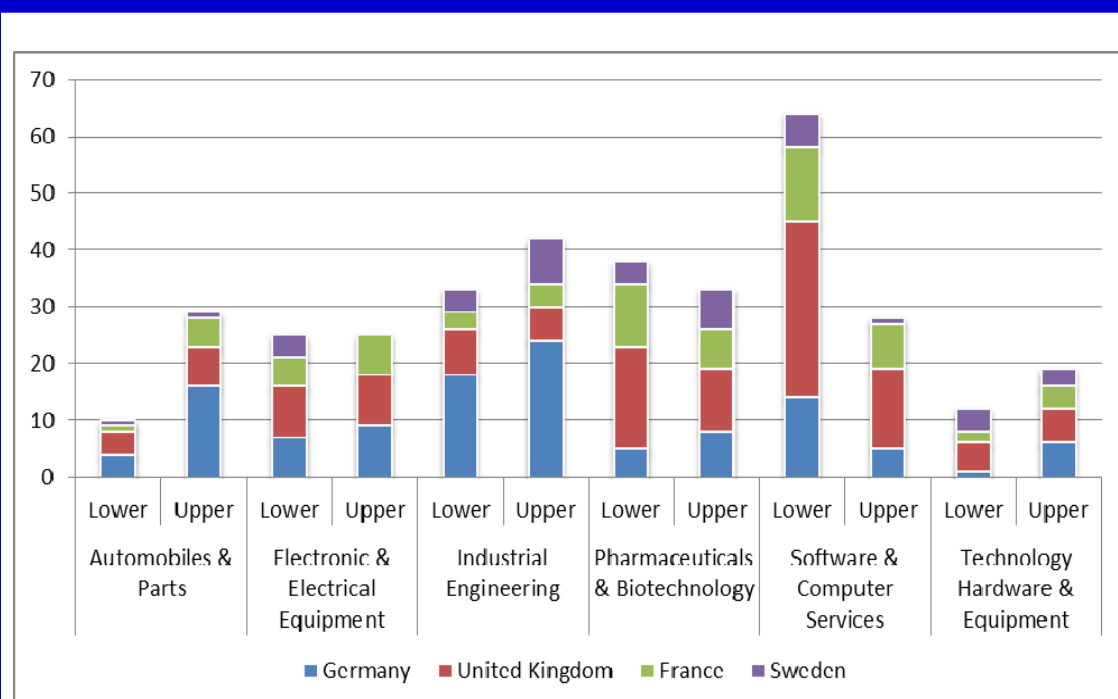
Table 4.1 Distribution of top and bottom EU companies in selected sectors		
Selected sectors	Top group of EU 1000 (number of firms)	Bottom group of EU 1000 (number of firms)
Pharmaceuticals & Biotechnology	59 (23%)	52 (21%)
Software & Computer Services	37 (14%)	74 (30%)
Technology Hardware & Equipment	29 (11%)	17 (7%)
Electronic & Electrical Equipment	38 (15%)	38 (16%)
Automobiles & Parts	36 (14%)	14 (6%)
Industrial Engineering	62 (24%)	50 (20%)
Total	261	245
Source: The 2013 EU Industrial R&D Investment Scoreboard. European Commission, JRC/DG RTD.		

A closer look at the lower reaches of the EU *Scoreboard* companies (i.e. EU top 1000 companies which do not belong to the World top 2000 companies) provides interesting insights regarding future potential leading EU companies. The general picture reveals that:

- More than 55% of these companies in the sectors of Electronic and Electrical Equipment, Pharmaceuticals & Biotechnologies and Software & Computer services have a higher R&D intensity than the average of the 527 EU companies.
- The share of companies with a higher R&D intensity than that of the top European companies exceeds 40% in the sectors of Industrial Engineering and Technology Hardware & Equipment.
- This proportion drops to about 20% in the sector of Automobiles & Parts since almost all the vehicle manufacturers are in the top 527.

The country distribution of the lower reach reveals that four countries account for about 75% of the total number of companies within the six selected sectors. The UK and Germany represent respectively 30% and 20% of the companies in these sectors while the proportions are about 15% and 10% for France and Sweden. Figure 4.1 below gives a more detailed view of the distribution of companies in the lower and upper reaches of the top 1000 EU for these four countries.

Figure 4.1 Main country and sector distribution of the EU 1000 companies



Source: *The 2013 EU Industrial R&D Investment Scoreboard*
European Commission, JRC/DG RTD.

With respect to the sector distribution of R&D intensity by country, the following main points are observed:

- In the Automobile and Parts sector, only UK companies display a higher R&D intensity than that of the average of the top 527 EU companies.
- All the Swedish companies operating in the Technology Hardware and Equipment sector show higher performances, as compared to the upper reach average.
- In the sector of Electronic and Electrical Equipment, French and German companies record a higher R&D intensity than the average of the top 527 EU companies.
- In the Industrial Engineering sector, Germany clearly outperforms as two third of its companies display an R&D intensity higher than the average of the upper reach, while the relative performance of the UK is not outstanding, as only one fourth of its companies exceed this average.
- Despite a lower number of companies, Germany also performs relatively better than France and the UK also in the Pharmaceuticals and Biotechnology sector. Indeed, all German companies have an above-average R&D intensity

(compared to that of the top 527 EU companies), while the same holds true for about 60% and 50% of French and UK companies, respectively.

- Swedish and UK companies in the Software and Computer Services sector show high performances as more than 80% display a higher R&D intensity than the upper reach average. In Germany, this proportion drops to about 60% while only half of the French companies are above this average.

Although these first observations provide relevant insights, the identification of future potential EU leading or top R&D companies deserves further detailed analyses at both the sector and company levels.

Trends of companies in the top 10 Member States of the EU

The companies based in the top 10 Member States account for 97.3 % of the total R&D of the 1000 EU companies (see table 4.2).

Among the group of the three top R&D investing countries (accounting for 67.5 % of the total R&D), companies based in Germany, the top R&D investor, had a double-digit average R&D growth, at 11.6 % compared with 9.5% increase in the previous year. Companies based in the UK and France increased R&D by 0.5% and 2.3 respectively, well below the world's average (6.2%). In terms of net sales, German and French companies grew by 6.7% and 6.8%, above the world's 4.2% increase. On the contrary, UK companies had reduced sales by 1.2%. The global sales growth of the automotive market contributed to the sales growth of German companies, showing, in particular, success in exporting to the growing markets of North America and Asia Pacific rather than being limited to the shrinking European market of 2012.

Apart from the group of the three top countries, companies increased R&D above the EU average in Italy (18.3 %), Ireland (10.7 %), the Netherlands (7.7 %) and Sweden (6.7 %). Among these companies, those based in Italy also had a double-digit growth in net sales (11.7%). Companies based in three countries decreased R&D in 2012: Finland (-10.3 %), Denmark (-3.0 %) and Spain (-2.1 %). Among these companies, those from Finland showed also a decrease of net sales (-1.3%).

It is important to remember that in many countries, the aggregate country indicators depend to a large extent on the figures of a very few firms. This is due, either to the country's small number of companies in the *Scoreboard* or to the concentration of R&D in a few large firms. For example:

- The R&D growth of Fiat (51.5%), accounting for more than 36 % of the R&D of companies based in Italy, contributed a significant part of the R&D growth of that country. Fiat's R&D growth was increased by its acquisition of Chrysler.
- Three companies from the Automobiles & Parts sector, accounting for 32% of the R&D of companies based in Germany, contributed a large part of the that country's R&D growth: Volkswagen (32.1 %), Robert Bosch (16.1 %) and BMW (17.2 %). Volkswagen's R&D growth was increased by its acquisition of Porsche and Man.
- Similar cases occur in Finland where Nokia's R&D investment accounts for almost 74% of the total R&D by Finnish companies and in Ireland with Seagate

Technology (12.6 %), Covidien (12.5%) and Accenture (11.2%), accounting for 60% of the R&D of companies based in Ireland.

Table 4.2 R&D trends of companies based in the top 10 EU Member States

Country	No. of companies	R&D Share within EU	R&D one year growth, %	Net sales One year growth, %
Germany	224	35.1	11.6	6.7
France	124	17.5	2.3	6.8
UK	252	14.8	0.5	-1.2
The Netherlands	55	8.3	7.0	4.1
Sweden	88	6.1	6.7	0.5
Italy	46	5.6	18.3	11.7
Finland	45	3.5	-10.3	-1.3
Spain	22	2.5	-2.1	3.9
Denmark	37	2.2	-3.0	10.3
Ireland	16	1.8	10.3	0.8
Total EU-10	909	97.3	6.1	4.3
For the sample of 1000 EU companies. Source: <i>The 2013 EU Industrial R&D Investment Scoreboard.</i> European Commission, JRC/DG RTD.				

Long-term performance of companies based in the 3 top EU Member States

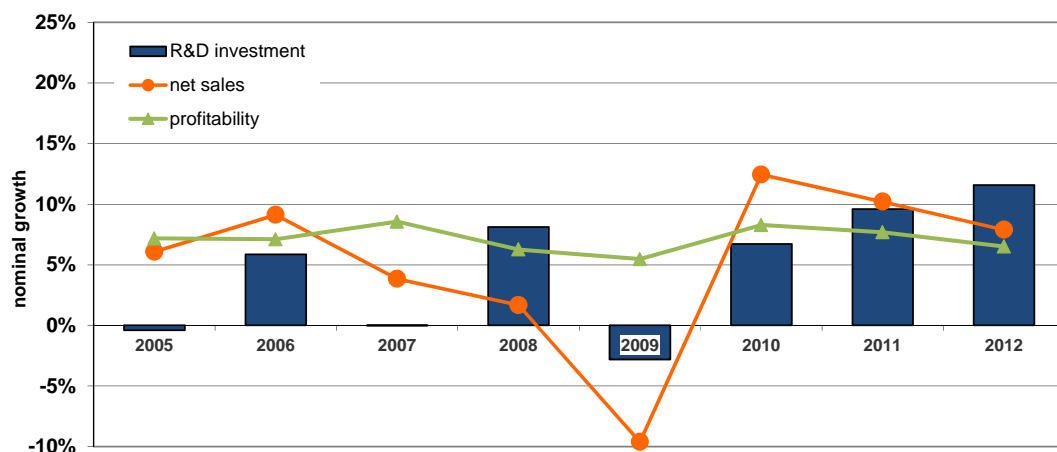
The annual growth rates of R&D investment and net sales and profitability of companies based in Germany, France and the UK is provided respectively in figures 4.2, 4.3 and 4.4 for the period 2004-2012. These figures are based on our history database comprising R&D and economic indicators over the whole 2004-2012 period from the EU 1000 dataset, including 135 from Germany, 81 from France and 122 from the UK.

The trends observed in these figures show the behaviour of these companies including the effects of the crisis that began in 2008. The following points are observed:

- Companies based in Germany seem to have recovered the levels of growth of R&D investment and net sales prior to the crisis.

- Since 2012, companies based in France have recovered a level of net sales similar to that of the period preceding the crisis; however, in terms of R&D the recovery observed in 2010-2011 was interrupted in 2012.
- For the companies based in the UK, the strong recovery shown in 2010-2011 was broken up in 2012 for net sales growth but R&D growth resumed from the low level reached in 2011.
- Sector composition of the country samples to a large extent reflects the differences observed in terms of profitability.

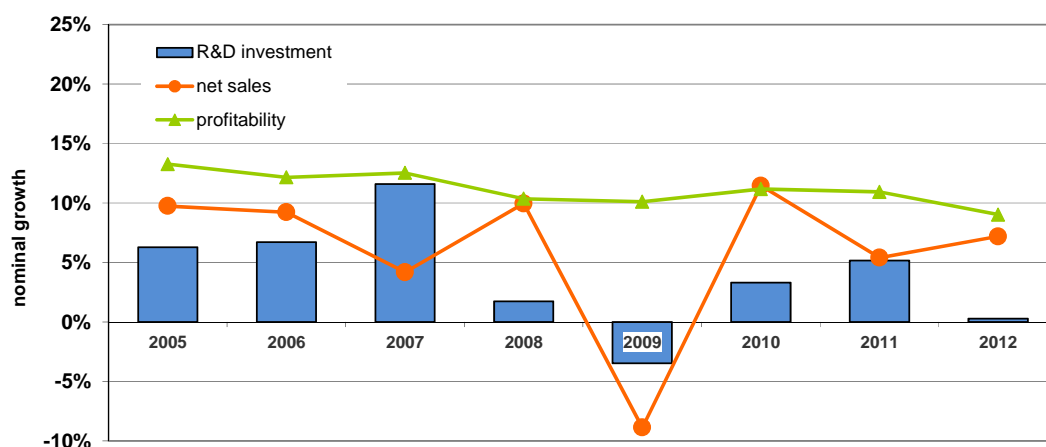
Figure 4.2 Annual R&D and net sales growth and profitability* by the German companies.



Note: for 135 German out of the EU1000 companies with data for the whole period
 * Profitability expressed as companies' profits as percentage of net sales

Source: The 2013 EU Industrial R&D Investment Scoreboard
 European Commission, JRC/DG RTD.

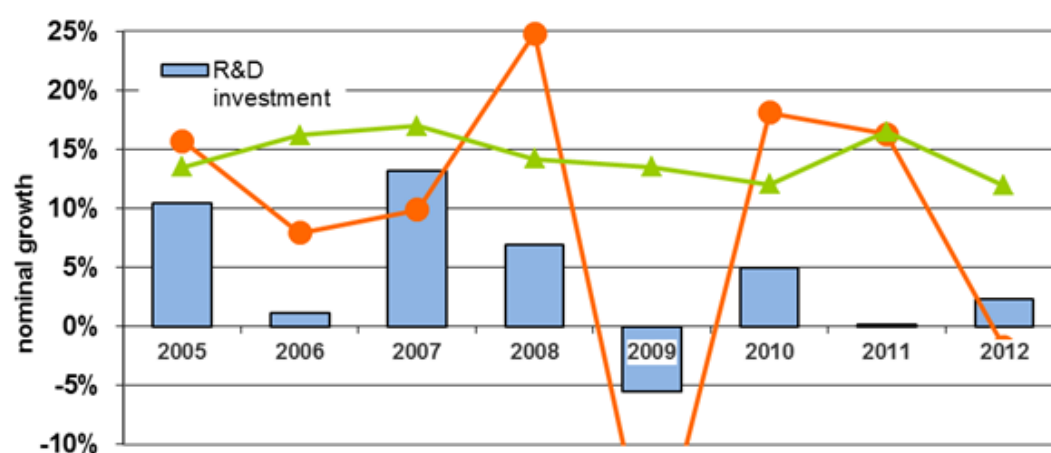
Figure 4.3 Annual R&D and net sales growth and profitability* by the French companies



Note: for 81 French out of the EU1000 companies with data for the whole period
 * Profitability expressed as companies' profits as percentage of net sales

Source: The 2013 EU Industrial R&D Investment Scoreboard
 European Commission, JRC/DG RTD.

Figure 4.4 Annual R&D and net sales growth and profitability* by the UK companies



Note: for 122 UK out of the EU1000 companies with data for the whole period.
 * Profitability expressed as companies' profits as percentage of net sales

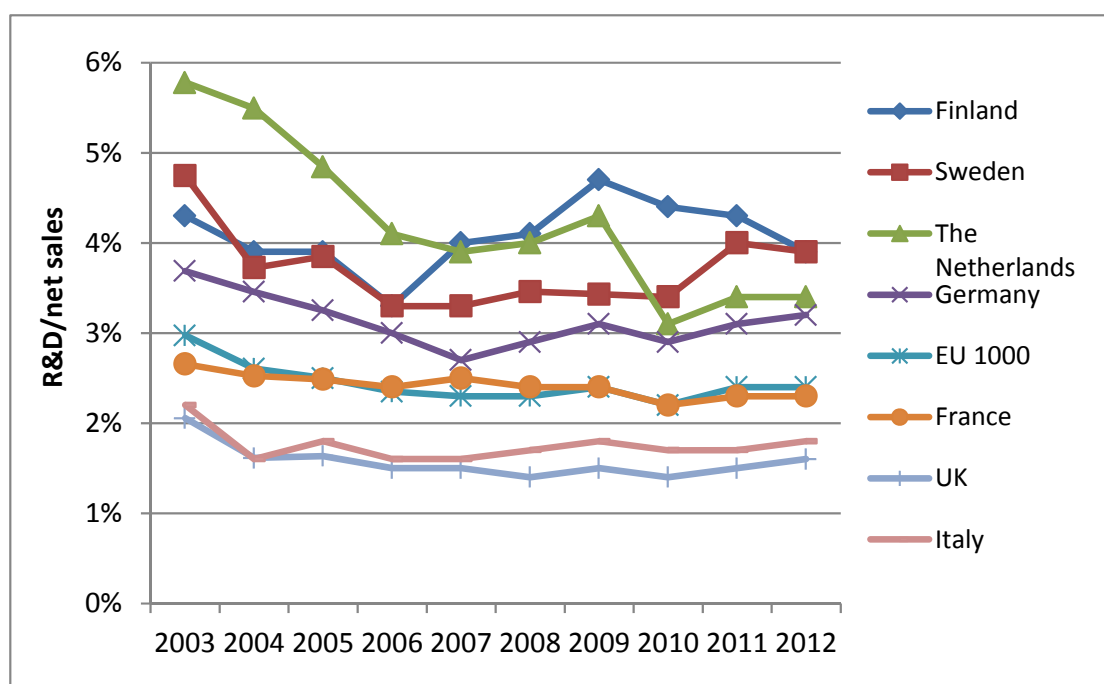
Source: The 2013 EU Industrial R&D Investment Scoreboard
 European Commission, JRC/DG RTD.

R&D intensity trends by companies based in selected Member States

In 2012, for the second consecutive year, the average R&D intensity of the EU-1000 companies increased slightly because of the higher increase of R&D investments compared to that of net sales, 6.1% vs. 4.3% (see Figure 4.5).

It is important to remember that a few large but low R&D intensity companies have a big effect on some country average R&D intensities. One example is Shell and BP for the UK. In the 2012, these companies contributed about 42% of the UK's *Scoreboard* company sales, so practically doubling the average R&D intensity of UK companies had they been left out.

Figure 4.5. Trends in R&D intensities for EU Scoreboard companies in selected Member States



For the EU1000 companies in each of the ten Scoreboards 2004-2013
 Source: The 2013 EU Industrial R&D Investment Scoreboard
 European Commission, JRC/DG RTD.

5. Sector focus: Health & biotechnology 2005-13

This chapter reviews the healthcare sector and focuses on therapeutic biotechnology and pharmaceuticals and analyses the role of the *Scoreboard* companies operating in this industry.

Key findings

- The global biotech market is expected to rise 54% from 2012 to 2017 with 60% being therapeutic biotech. This demonstrates the growing importance of biotech in replenishing the new drug pipelines of pharmaceutical companies.
- The demand for new medicines is growing due to rising and ageing populations and the increasing wealth of emerging nations. But pharmaceutical companies over the last decade have faced the 'patent cliff' of expiring blockbuster patents, increased regulation and decreasing productivity of their conventional R&D. At the same time technological advances in therapeutic biotech have opened up new opportunities.
- The big pharmaceutical companies have responded to these challenges first by pharmaceutical acquisitions to reduce costs and then by biotech acquisitions and collaborations to enhance their new drug pipelines. The Scoreboard allows us to track these changes at company level from 2005 to 2012.
- The Scoreboard shows that the therapeutic biotech sector is now dominated by the US which has all the top five biotech companies and eight of the top ten. But there are a number of examples of EU companies which show both high performance and the ability to grow to a sustainable size through well-chosen collaborations.

5.1 Introduction and scope

This chapter is concerned with the development of R&D-led healthcare companies over the last decade from 2005 to 2013. There are two main ICB sectors contributing to healthcare R&D – pharmaceuticals & biotechnology and health. These two sectors account for just over 20% of the total R&D in the world top 2000 companies but constitute two of the eight highest R&D intensity sectors (intensity over 4%). Total health sector R&D is only about 12% of the R&D in pharmaceuticals & biotechnology

We are going to focus on R&D-led healthcare companies so we will exclude biotech companies in non-healthcare applications which account for about 40% of global biotech sales. The reason is that therapeutic biotechnology dominates the biotech sector in the *Scoreboard* and is accounting for a larger and larger proportion of the new drugs launched by pharmaceutical companies. The health sector will be covered only briefly for reasons of space and because the biotech/pharma story is so significant. The area of diagnostics, however, will be mentioned towards the end of this chapter because of its growing importance in the future of biotech/pharma. Roche is a leader in diagnostics which accounts for about one fifth of its revenue.

The profile of the global biotechnology sector and the split between sub-sectors according to Marketwatch's 2013 survey is:

- The global biotech market is forecast to rise from \$304bn in 2012 to \$468.1bn in 2017, an increase of 54%
- The market segmentation in 2012 was 60% medical/healthcare, 13.8% food & agriculture, 7% environment & industrial processing and 19.2% services (including technology services)
- The segmentation by region was the Americas 45.4%, Europe 26.1%, Asia Pacific 26.1%, the Middle East & Africa 2.4%. There are significant differences between regions with the US having 61.6% in healthcare, Europe 68.1% but Japan only 35.9%

We will be focusing on healthcare in this chapter with particular reference to the growing importance of biotech to pharmaceutical companies with up to 50% of new drugs expected to come from biotech by 2018 compared to just 12% in 2004 (data from EvaluatePharma's 2013 report). But before discussing the details and the companies involved we need to describe the main features of the business environment in which these major changes are occurring.

5.2 The business environment for healthcare

There are four major trends occurring in healthcare which are driving changes in the whole business environment. These are:

- The **increasing demand** for healthcare due to ageing populations and the growing wealth of developing countries. The proportion of the world population over 60 will more than double from 10% in 2000 to 21% in 2050. And in China it will more than triple from 10% to 32.8% by 2050. The combination of rising and ageing populations and increasing GDP means, according to Ernst & Young, that up to 90% of the growth of the pharmaceutical industry will be provided by emerging markets by 2020.
- **Technological innovations** range from biotech drugs or software-driven MRI scanners and radiotherapy systems to micromechanical devices like drug-eluting stents and robotic-assisted surgery. And coming over the horizon is personalised medicine with drugs tailored to a patient's genetic makeup – this combines diagnostics with tailored drugs. These changes have already reduced death rates from heart disease and cancer. Now biotech innovations are enabling patients with serious diseases like HIV and Hepatitis C to be treated and there are new biotech drugs being developed to treat more cancers and serious conditions like rheumatoid arthritis.
- **Increased regulation** and demands for proof of increased efficacy for new drugs have occurred as a response to safety concerns and rising costs. The FDA (US Food & Drug Administration) tightened up its approval and other procedures in 2007 following cases such as the withdrawal of Merck's painkiller Vioxx in 2004 after it was shown that the drug increased the risk of a heart attack. And Pfizer was fined \$2.3bn in 2009 for off-label marketing of its arthritis drug. There has also been a move to introduce cost-effectiveness analysis (CEA), particularly in the single-payer health systems of Europe. NICE (National Institute of Clinical Excellence) in the UK was an early example (1999). CEA supports the notion that higher prices can be charged for more efficacious drugs which should encourage R&D.

- The **business response** of the big pharmaceutical companies to the challenges of patent expiries, increased regulation, reduced R&D productivity (because of the increasing difficulties of finding new blockbuster small molecule drugs) and to rapid biotech advances has been via increased M&A and collaborations with smaller biotechs.

We will expand on the last of these trends to set the scene for the discussion in the next section of the trends in R&D, sales and profits of both biotech and pharma companies in the Scoreboard from 2005 to 2012 and how these reflect the changes in the healthcare landscape and illustrate the way in which different companies have responded to them.

While global pharmaceutical companies have benefited from the increasing demand for new and better drugs, they have also faced a series of challenges over the last decade including increased regulation and CEA. The two most serious ones have probably been the expiry of patents on a whole series of blockbuster drugs and the decreasing productivity of R&D as new blockbusters based on conventional small molecule drugs became harder to discover.

Once a drug loses patent protection generics siphon off up to 90% of its sales. The large number of patent expiries occurring between 2010 and 2015 has been termed the 'patent cliff' and all the major pharmaceutical companies have been affected by it. The 'cliff' extends from 2010 to 2016. The scale and importance of the cliff is demonstrated by Pfizer which, just between 2010 and 2012, lost patent protection on drugs like Lipitor, Protonix and Geodon which made up 42% of its revenue. Lipitor was the world's top selling drug with peak revenues of \$12.9bn in 2006. And Chemistry World reported last July that Eli Lilly is freezing the pay of its employees in 2014 to save money ahead of the expiry of two key patents which will cause revenue to fall by 20%.

Big pharma companies have responded to these massive losses in sales in three main ways. Cost cutting, M&As between pharmaceutical companies, more focused R&D and refilling of pipelines using biotech drugs from biotech companies (through acquisition and collaboration). Cost cutting has involved all the functions of these companies. R&D has been reduced in some, such as Pfizer which closed its UK research laboratories in Kent which had a long record of innovation including discovering the drug Viagra. Other companies used mergers and acquisitions to enable them to reduce the R&D of the newly combined companies. In manufacturing there has been a trend to use outside contract manufacturing companies with the closure of in-house manufacturing plants. And big savings have been made in marketing and selling expenses by co-marketing and downsizing sales with ZS Associates estimating that the number of US pharmaceutical sales representatives would shrink by 26% from 2007 to 2012.

In the next section we use the Scoreboard to explore two issues in more detail. These are the M&A deals between 2004 and 2013 and the development of new drugs using biotechnology. One of the first pharmaceutical companies to understand the importance of biotechnology was Roche which, in 1990, took a majority stake in Genentech, the first ever therapeutic biotech company which was formed in 1976 in the US. It now owns 100% of Genentech which is responsible for many of Roche's pipeline drugs.

5.3 A multi-year Scoreboard survey of the biotech/pharma sector

In this section we use the run of R&D Scoreboards from 2005 to 2013 to track the R&D and business performance of biotech and pharma companies. We will first give an overview of the whole company set, examine the characteristics of the larger companies and then look at the way some typical companies have developed over the decade and faced the challenges described in section 2. We will conclude by looking at some mainly smaller biotech companies and examining how they have grown and the nature of collaborations they have formed with large pharmaceutical companies.

5.3.1 Pharmaceutical & biotechnology companies in the 2013 Scoreboard

There are 214 companies in total in the Pharmaceuticals and Biotechnology sector out of the world top 2000 included in this year's Scoreboard. This 10.7% of the companies accounts for 18% of the R&D in the Scoreboard and the sector has by far the largest R&D intensity (14.4%). There are five companies from the sector in the overall top ten by R&D in the Scoreboard, two from Switzerland and three from the US.

The 214 companies have been assigned either to biotech or pharma. There is inevitably a grey area between the two so not all the assignments may be the same as those made in stock market classifications such as the Nasdaq sectors. These assignments give us 89 companies in biotech and 125 in pharma. Table 5.1 gives an overview of the two sectors and the contributions of each world region. The US has 74.2% of the biotech companies and 86.0% of the R&D. The EU has 20.2% of the companies and 9.9% of the R&D so the EU companies are on average much smaller. In pharmaceuticals the US has 26.4% of the companies but 38.4% of the R&D whereas the EU has 32.0% of the companies but 30.0% of the R&D.

Table 5.1 Overview of the Scoreboard companies in the Pharmaceuticals & Biotechnology sector				
	EU	US	Others	World
Biotechnology				
No. companies	18	66	5	89
Employees	18,832	67,986	17,269	104,087
R&D investment, €m	1,190	10,300	445	12,000
Net Sales, €m	5,450	40,100	4,890	50,400
R&D intensity ^(*)	17%	25%	9%	23%
Profitability ^(*)	13%	28%	24%	26%
Pharmaceuticals				
No. companies	40	33	52	125
Employees	596,006	589,294	529,622	1,714,922
R&D investment, €m	26,500	33,700	27,500	87,700
Net Sales, €m	192,000	225,000	208,000	624,000
R&D intensity ^(*)	14%	15%	13%	14%
Profitability ^(*)	19%	23%	16%	19%

Given the large number of companies we will focus on the top 25 in each category and use the run of Scoreboards to understand some of the big changes that have occurred over the last eight years in response to the challenges we outlined in section 5.2.

5.3.2 Sector trends 2005-2012

R&D in both the biotech and pharma sub-sectors is dominated by the larger companies. For example, the top 10 biotechs account for 63% of the R&D of all 89 companies while the top 10 pharmas account for 58% of the R&D of all 125 companies. The characteristics of the top 30 companies from each subsector are:

- **Biotechnology:** Top 30 companies by R&D with R&D ranging from €62m (and sales €0.8m) to R&D of €2.3bn (and sales €12.6bn). A total of 25 of these companies are from the US, 4 from the EU and one from Australia. All are in therapeutic biotech except two of those from the EU – Novozymes in industrial biotech (enzymes) and Qiagen (sample and assay technologies).
- **Pharmaceuticals:** Top 30 companies by R&D with R&D ranging from €0.33bn (and sales €2bn) to R&D of €7bn (and sales €37.8bn). A total of 9 of these are from the US, 13 from Europe (10 from the EU and 3 from Switzerland), 7 from Japan and one from Israel.

The relative numbers of EU and US companies in the two sectors show that the US dominates the world in larger therapeutic biotech companies and that Japan lags behind the EU in both areas.

Now the companies in the top ranks have changed markedly from 2005 to 2013. To understand this we will discuss M&As in the pharma sector, the rise of biotechnology and the modes of collaboration between big pharma companies and smaller, growing companies that are mainly biotechs.

M&As between large pharmaceutical and biotech companies

Some of the trends in the pharmaceutical sector can be seen from a comparison of the top 25 in 2005 and 2012. Of the top 25 pharmaceutical companies by R&D in 2005, only 17 made it into the top 25 of 2012. This was because five of them were acquired while the R&D of the other three did not increase enough to reach the top 25 of 2012. Wyeth was acquired by Pfizer for €45.5bn, Schering by Bayer for €17bn, Schering-Plough by Merck (US) for €25.5bn, Altana by Nycomed for €4.6bn and Schwarz Pharma by UCB for €3.8bn. Pfizer had already acquired Warner-Lambert in 2000 and Pharmacia in 2003.

Table 5.2 Top 25 Pharmaceutical R&D investors in 2005 seven year later

Company	Country	R&D 2012/2005	World Rank 2005	World Rank 2012
Pfizer	USA	91%	2	10
Johnson & Johnson	USA	109%	7	9
GlaxoSmithKline	UK	93%	10	20
Novartis	Switzerland	169%	13	7
Sanofi-Aventis	France	121%	16	15
Roche	Switzerland	191%	19	6
Merck US	USA	184%	21	8
AstraZeneca	UK	118%	28	33
Eli Lilly	USA	156%	32	26
Wyeth	USA	-	36	Acquired by Pfizer - Deal value: 45,536,102 th EUR
Bristol-Myers Squibb	USA	122%	37	40
Bayer	Germany	169%	46	36
Schering-Plough	USA	-	56	Merged with Merck US - Deal value: 25,487,802 th EUR
Abbott Laboratories	USA	212%	58	35
Boehringer Ingelheim	Germany	206%	61	42
Takeda Pharmaceutical	Japan	280%	74	41
Schering	Germany	-	77	Acquired by Bayer AG - Deal value: 17,000,000 th EUR
Merck DE	Germany	212%	97	73
Novo Nordisk	Denmark	205%	101	79
Eisai	Japan	187%	121	108
UCB	Belgium	153%	133	146
ALTANA	Germany	-	146	Acquired by Nycomed - Deal value: 4,600,000 th EUR
Yamanouchi Pharmaceutical	Japan	-	156	70 (now Astellas Pharma Inc., they merged with Fujisawa Pharmaceutical Co., Ltd)
Mitsubishi Pharma	Japan	-	169	Now controlled by Mitsubishi Chemical Holdings Co.
Forest Laboratories	USA	194%	177	162
Allergan	USA	226%	185	149

Table 5.3 Top 25 Biotechnology specialised R&D investors in 2005 seven year later

Company	Country	R&D 2012/2005	World Rank 2005	World Rank 2012
Amgen	USA	131%	45	47
Biogen Idec	USA	160%	110	111
Serono	Switzerland		129	Acquired by Merck DE - Deal value: 4,737,838 th EUR
Genzyme	USA		158	Acquired by Sanofi-Aventis - Deal value: 14,055,061 th EUR
Chiron	USA		173	Acquired by Novartis AG - Deal value: 4,304,064 th EUR
MedImmune	USA		190	Acquired by AstraZeneca - Deal value: 11,387,012 th EUR
Applera	USA		220	Acquired by Invitrogen (now Life Technologies Corporation)
Millennium Pharmaceuticals	USA		230	Acquired by Takeda America Holdings - Deal value: 5,675,120 th EUR
Kyowa Hakko Kogyo	Japan		255	Now controlled by Kirin Holdings Co. Ltd.
Gilead Sciences	USA	567%	259	82
Human Genome Sciences	USA		328	Acquired by GlaxoSmithKline - Deal value: 2,463,689 th EUR
Protein Design Labs	USA		383	No more in Scoreboard
Meril	UK		417	Acquired by Sanofi-Avensis - Deal value: 2,713,329 th EUR
Celgene	USA	951%	421	88
Medarex	USA		451	Acquired by Bristol-Myers Squibb - Deal value: 1,674,610 th EUR
Theravance	USA	83%	482	793
OSI Pharmaceuticals	USA		484	Acquired by Astellas Pharma - Deal value: 3,343,026 th EUR
Novozymes	Denmark	182%	490	425
Abgenix	USA		507	Acquired by Amgen. - Deal value: 2,187,840 th EUR
CV Therapeutics	USA		540	Acquired by Gilead Sciences - Deal value: 1,062,355 th EUR
Vertex Pharmaceuticals	USA	623%	546	178
CSL	Australia	309%	557	330
NPS Pharmaceuticals	USA	81%	567	925
Regeneron Pharmaceuticals	USA	114%	571	720
Invitrogen	USA		589	346 (now Life Technologies Corporation, under acquisition by Thermo Fisher Scientific Inc. HERMO FISHER SCIENTIFIC INC. - Health Care Equipment & Services)

Despite this acquisition activity, there was only a modest increase in R&D from 2005 to 2012 for many of the large pharmaceutical companies. Pfizer's R&D actually decreased over these eight years while that of AstraZeneca, GlaxoSmithKline and Sanofi increased by less than 25%.

The pace of change was even faster in biotech. Of the top 25 biotechs of 2005 shown in the Scoreboard, only eight survived to 2012 (one under a new name) and two of them were not therapeutic biotechs (Novozymes and Qiagen). The fate of the other 17 is summarised below:

- Ten biotechs were acquired by pharmaceutical companies (three by Sanofi, two by AstraZeneca and one each by GSK, Johnson & Johnson, Merck, Novartis and Takeda)
- One was acquired by another biotech (Agennix)
- Six did not make the 2013 Scoreboard (one being a demerger)

We should also mention that, in 2009, Roche acquired full ownership of Genentech for \$46.8bn (it already had a majority shareholding). The increases in R&D amongst profitable biotechs were also very large. There are 14 biotechs appearing in the 2013 Scoreboard which both tripled R&D from 2005 to 2012 and had a positive profitability of at least 4%. These are shown in table 5.4.

Company	Bio Rank	SB Rank	Country	R&D 2012 (mil €)	R&D intensity 2012	R&D growth	Profitability 2012	Empl. 2012
GILEAD SCIENCES INC	2	82	US	1334	19%	504%	43%	5000
CELGENE CORP	3	88	US	1206	29%	914%	35%	4700
LIFE TECHNOLOGIES CORPORATION	7	346	US	259	9%	250%	19%	10000
ILLUMINA INC	11	460	US	175	20%	692%	22%	2400
UNITED THERAPEUTICS CORP	13	572	US	131	19%	381%	46%	623
ALKERMES PLC	16	702	IE	101	23%	3322%	14%	1230
EMERGENT BIOSOLUTIONS INC.	21	783	US	91	43%	554%	11%	877
VIROPHARMA INC	38	1154	US	51	16%	538%	8%	410
BTG PLC	39	1185	UK	49	18%	383%	9%	569
ACORDA THERAPEUTICS, INC.	50	1362	US	41	18%	318%	8%	378
GENUS PLC	58	1486	UK	36	9%	394%	16%	2189
GENOMIC HEALTH, INC.	60	1501	US	36	20%	422%	4%	612
SPECTRUM PHARMACEUTICALS, INC.	65	1601	US	32	16%	216%	31%	193
LUMINEX CORP	70	1646	US	31	20%	628%	11%	709

Table 5.4 shows key data for Gilead Sciences, Celgene, Life Technologies, Illumina, United Therapeutics, Alkermes, Emergent Biosolutions, Viropharma, BTG, Acorda Therapeutics, Genus, Genomic Health, Spectrum Pharmaceuticals and Luminex.

The first six of these are large biotechs since they feature in the top 14 biotechs by R&D in this year's Scoreboard with Gilead Sciences and Celgene in second and third places. Amgen remains at #1 as in 2005 with Biogen Idec as #4 (#2 in 2005). Of the 14 biotechs, eleven are from the US, two from the UK and one from Ireland.

The message of this chapter is that large pharmaceutical companies have adopted two strategies in the last decade to overcome the challenges outlined in section 2. The first was

the acquisition of other pharmaceutical companies, primarily to reduce costs. The second has been the bolstering of their pipelines through the acquisition of biotech companies or collaborations with them. We now look at the modes of collaboration between the two.

5.3.3 Collaboration between biotech and pharma companies

The biotechnology industry was started in 1976 with the foundation of Genentech which now employs some 12,500 people and, since 2009, is 100% owned by Roche, an example of acquisition as an extreme form of collaboration. We have seen above how eleven of the top 25 biotechs in 2005 were acquired, ten by pharmaceutical companies. Acquisitions of this type will undoubtedly continue but other types of collaboration are important for small biotechs that aim to grow fast but also remain independent. This type of collaboration is particularly important for smaller EU biotechs which need to grow larger to compete effectively with the many larger US ones.

We will illustrate four different modes of collaboration with examples of biotech companies that are growing in these four ways. The data is mainly taken from the companies' own websites.

- The first is Abcam, a biotech which illustrates the use of marketing collaborations used to expand its internet sales. It is a £122m sales Cambridge company that supplies antibodies and proteins to therapeutic and other biotech researchers all over the world through its innovative website which offers 122,000 products. It develops and makes only one third of its products with the other two-thirds sourced through collaborations. It provides comprehensive technical data sheets and quality control for these products which are all marketed through its website. Its growth has been mainly organic but with related acquisitions. Abcam had a September 2013 cash pile of over £38m with no debt.
- The second is MorphoSys, a biotech which has a pipeline of 81 potential drugs based on antibodies with 21 of these already in clinical trials. It is collaborating with several pharmaceutical companies on pipeline drugs and derives income from these through licence fees and milestone payments and will gain royalty streams when new partnered drugs are launched. Partners include Bayer, GSK, Johnson & Johnson, Novartis, Pfizer and Roche. It also funds development of certain proprietary drugs out of its own cash resources so that it can agree more lucrative partnerships for these at a later stage (clinical Phase II or III). It has just signed deals with GSK and Celgene for its two most advanced drugs. Even before these deals MorphoSys had a cash pile of €166m.
- The third is Oxford Nanopore which is developing novel DNA and RNA sequencing instruments one of which will sell for less than \$1,000. It is a private company valued at £328m in June 2013 and was spun out of Oxford University by IP Group, a university research commercialisation company. Oxford Nanopore has just raised another £40m of funds for further growth. University commercialisation companies such as IP Group, Fusion IP and Imperial Innovations are helping to spin out new companies from university R&D in biotech and many other R&D-intensive sectors and then manage their growth to a viable size at which they can be listed.
- The fourth is Regeneron Pharmaceuticals, a US biotech specialising in antibody-derived drugs that illustrates collaborations with EU pharmaceutical companies. It has its first

blockbuster drug on the market – Eylea – and has at least three more potential blockbusters in its pipeline. It collaborates with Bayer on Eylea with Bayer marketing the drug outside the US and Regeneron retaining full US rights. Regeneron is also collaborating with Sanofi on the joint development of other drugs for diseases such as asthma and rheumatoid arthritis. Sanofi has a 16% shareholding in Regeneron and can increase this to 30% under their existing agreement.

These four examples illustrate the different ways in which smaller biotechs can grow to a size where they can be self-sustaining through generating enough cash to fund the development of a strong pipeline and arrange beneficial terms for marketing their successful drugs or devices. Accumulating an adequate cash pile is an important step in this process.

5.4 The prospects for therapeutic biotech companies

It is clear from the previous sections that biotechnology is of increasing importance and is likely to be generating over 50% of new drugs by 2018. The US dominates therapeutic biotechnology, the largest segment of biotechnology. It is home to all five of the top biotechs with R&D over €500m and to nine of the top ten. European and other pharmaceutical companies have realised the importance of biotech as the likely source of the majority of new drugs in the future. They have therefore acquired biotech companies and collaborated with them in various ways.

However, Europe has a proud record of scientific discovery in biotech including such milestones as the structure of DNA and the discovery of antibodies. Europe would benefit from having some larger and independent biotech companies to build up its base of skills and commercial expertise in this important sector to gain full commercial benefits from its fundamental R&D. This chapter illustrates some of the ways in which this can be done ranging from university spin-out companies growing under the umbrella of commercialisation companies to the development of a well-stocked biotech pipeline using a combination of early and late stage partnerships with pharmaceutical companies.

6. Company foreign direct investments

This chapter looks at the foreign direct investments (FDIs) of Scoreboard companies as a proxy of their internationalization strategies.

FDI is defined as an investment made to acquire lasting interest in enterprises operating outside of the economy of the investor. The UN defines control in this case as owning 10% or more of the ordinary shares or voting power of an incorporated firm or its equivalent for an unincorporated firm. Additional to having an equity capital or reinvested earnings in an enterprise, there are other ways in which foreign investors may acquire an effective voice in the management of an enterprise. These include franchising, subcontracting, management contracts, turnkey arrangements¹², leasing, licensing and production-sharing.

There are two types of FDIs used for market entry purposes: greenfield FDIs and mergers and acquisitions (M&As).

Although greenfield FDI projects account for a much smaller share in the total value of FDI, the number of greenfield projects greatly surpasses the number of M&A projects (World Investment Report, UNCTAD, 2012).

Greenfield Foreign Direct Investments consist in the expansion of existing facilities or a direct investment in new facilities (in an area where no previous facilities exist). Greenfield FDIs are the primary objective of a host nation's promotional efforts, as they create new production capacity and jobs, transfer technology and know-how, and can lead to linkages to the global marketplace. Investing companies, on the other hand, have aims such as lowering costs, avoiding tariff barriers, using local skills and incentives and understanding the specific needs of local markets.

Matching the first 1500 Scoreboard companies¹³ with data on greenfield FDIs¹⁴, the objective is to show how the top world R&D spenders are locating and re-organizing their industrial activities (e.g., manufacturing, research, development and testing) around the world and across sectors through outflows of FDIs.

Key Findings

- The EU plays a major role in the international scenario both as the main source and destination of knowledge intensive FDIs. 22% of the total number of FDIs in R&D is destined to the EU, while the US receives only 8 % of projects in R&D.
- Six out of the ten countries with the highest number of international projects are European.
- The EU attracts more technological intensive projects than resource-saving investments compared to the other economies.
- FDIs in R&D are concentrated mainly in the three sectors of Technology Hardware and Equipment, Automobiles & Parts and Pharmaceuticals & Biotechnology.

¹² A turnkey contract is a business arrangement in which a project is delivered in a completed state. Rather than contracting with an owner to develop a project in stages, the developer is hired to finish the entire project without owner input.

¹³ Sample corresponding to the 2012 EU Industrial R&D Investment Scoreboard edition.

¹⁴ Greenfield investment data is derived from the © 2013 fDi Markets database (a service from the Financial Times Limited 2013), which accounts for more than 110,000 greenfield investment projects around the world for the period 2003-2011. Information on the greenfield FDI project is derived from different media sources and can be interpreted as a commitment to invest validated with company sources.

Overview of Scoreboard Greenfield FDIs

The total number of greenfield FDI projects undertaken during the period 2003-2012 by the world top 1500 R&D investors is 27,208 for a total capital expenditure of 2.03 trillion Euros.

For the purpose of the analysis, intra-European FDIs and intra-state US investments are excluded.

The breakdown of FDIs by activity and geographical area and the growth rates over the period of the different categories of investments (manufacturing, R&D and others) are presented in Table 6.1.

Greenfield FDIs in manufacturing activities represent the highest share, both in terms of value (60% of total capital investments) and number of projects (39%). The shares for FDIs on R&D are 5% and 12% respectively.

Table 6.1: Decomposition of FDIs by activity

FDI type	N. of projects	€bn
Manufacturing	10514	1219
Sales & Marketing	4311	36
Research & Development	3342	97
Retail	2035	42
Logistics, Distribution & Transport.	1270	83
Business Services	1229	31
Headquarters	1086	29
Maintenance & Services	559	8
ICT & Internet Infrastructure	540	80
Education & Training	475	5
Extraction	474	254
Customer Contact	352	3
Electricity	343	110
Technical Support	277	3
Shared Services	228	4
Construction	123	24
Recycling	50	2
Total	27208	2030

Source Region	Outflows (% €2030 bn)	Projects (% of 27208)	Destination Region	Inflows (% €2030 bn)	Projects (% of 27208)
Asian Tigers	7	4	Asian Tigers	5	6
BRICS	7	4	BRICS	34	34
EU	42	36	EU	9	17
Japan	14	19	Latin America	8	6
RoW	2	2	RoW	18	13
Switzerland	2	4	South Asia	17	14
USA	25	30	USA	8	10

Source: The 2013 EU Industrial R&D Investment Scoreboard, European Commission, JRC/DG RTD.

Looking at the geographical distribution, top EU R&D investors appear as the main source of greenfield FDIs, both in terms of value (42% of the total versus 25% for their US counterparts) and of number of projects (36% versus 30% for US top R&D investors). These figures confirm the important role played by the EU as the main source of FDIs¹⁵. In terms of destination, BRICS countries (Brazil, Russia, India, China and South Africa) appear to be the main beneficiaries (34% of total value and 34% of the total number of projects). The EU attracts 9% of the value and 17% of the projects (versus 8% and 10% respectively for the US).

Table 6.2 highlights the top 10 European (red) and non-European (black) countries responsible for the larger shares of worldwide direct investment flows. The table reports the number of investment projects, estimated capital expenditure (in billions of Euro) and estimated number of jobs created (in thousands).

Table 6.2: FDI outflows and inflows, 2003-2012

Top 10 source countries (86% of total n. of projects)

Source Region	N. of projects	€bn	Jobs (x1000)
United States	8252	505	1808
Japan	5156	289	1437
Germany	3291	205	890
France	1672	164	440
UK	1526	131	392
Switzerland	1180	43	203
South Korea	769	96	364
Netherlands	662	99	157
Sweden	534	18	110
Italy	499	69	170

Top 10 destination countries (55 % of total n. of projects)

Destination Country	N. of projects	€bn	Jobs (x1000)
China	4353	325	1522
United States	2618	166	410
India	2505	142	902
Russia	1162	81	366
Brazil	980	131	411
UK	817	29	95
Singapore	681	44	114
Mexico	660	54	268
Canada	616	72	96
Thailand	613	26	205

Source: The 2013 EU Industrial R&D Investment Scoreboard, European Commission, JRC/DG RTD.

¹⁵ Analysing a different sample, similar results have been reported by the "Foreign direct investment statistics" (Eurostat), http://epp.eurostat.ec.europa.eu/statistics_explained/index.php/Foreign_direct_investment_statistics.

The two top investing countries are the US and Japan, followed by a set of EU countries: Germany, France, and the UK. Also, the last three top 10 investing countries are the Netherlands, Sweden, and Italy.

In contrast, the top destination countries are the emerging economies of China, India, Russia, and Brazil, and the US (in second place). The estimated number of jobs that are expected to be created by the FDI projects is proportionate to their magnitude. Moreover, most of the jobs are estimated to be created by US projects and expected to be created in China.

Locating R&D abroad: how attractive is the EU for greenfield FDI?

Table 6.3 shows the flows of FDI in R&D from region to region. BRICS and European countries are the most attractive: top R&D investors locate 41% of their total number of FDIs in R&D in the BRICS and 22% in the EU (we exclude in this account intra-EU flows, to make it comparable with other world regions). In comparison, the US receives only 8 % of R&D projects. Considering the geographical location of the companies performing such FDI in R&D, 26% of the projects originate in Europe, 11% in Japan, and 52% in the US.

Table 6.3: Flows of FDIs in R&D, 2003-2012 (% of n. of projects)

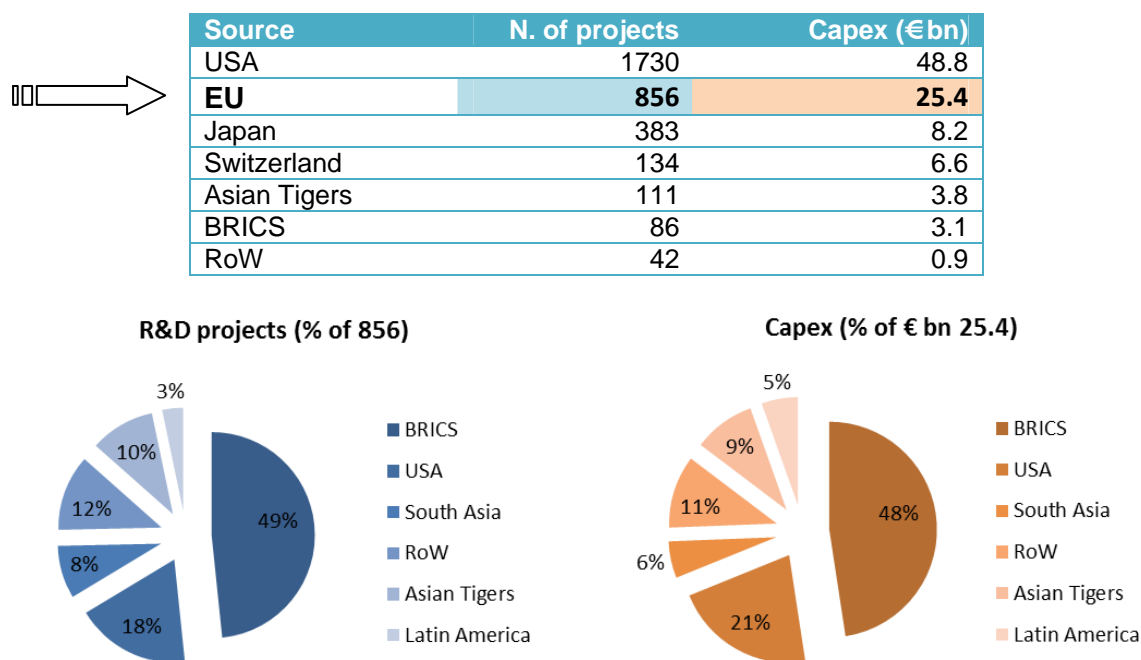
Source Region	Destination Region							Total
	Asian Tigers	BRICS	EU	Latin Am	RoW	South Asia	USA	
Asian Tigers	0.09	1.65	0.57	-	0.18	0.12	0.72	3.32
EU	2.60	12.39	-	0.84	3.05	2.12	4.61	25.61
Japan	1.38	3.92	2.63	0.03	0.33	1.14	2.03	11.46
RoW	0.03	0.39	0.51	0.03	0.15	-	0.15	1.26
Switzerland	0.42	1.32	1.20	0.09	0.45	0.03	0.51	4.01
USA	4.61	20.89	15.83	1.94	4.67	3.83	-	51.77
BRICS	0.09	0.48	1.11	0.18	0.33	0.18	0.21	2.57
Total	9.22	41.02	21.84	3.11	9.16	7.42	8.23	3,342

Source: The 2013 EU Industrial R&D Investment Scoreboard, European Commission, JRC/DG RTD.

Table 6.4 displays in more detail the destination of the 856 FDI projects in R&D made by the EU Scoreboard companies during the period 2003-2012. The main destinations are the BRICS (49% of projects and 48% of the total capital investment) and the US (18% and 21%, respectively).

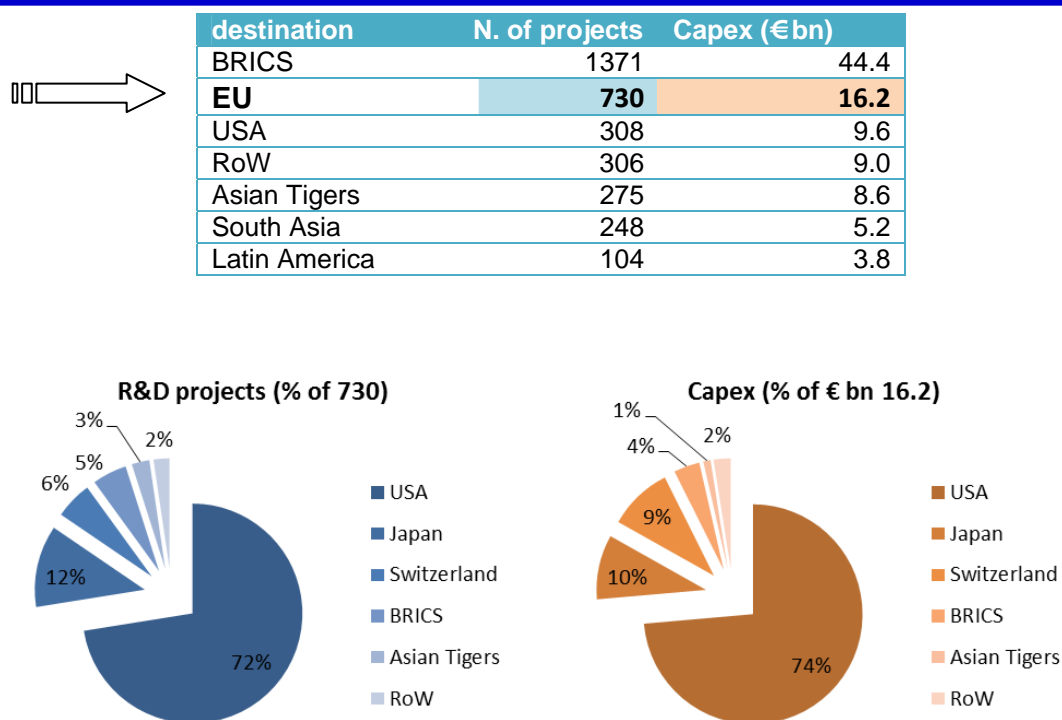
Table 6.5 mirrors the same exercise, analysing the inflows of R&D projects undertaken by non-EU Scoreboard companies into EU countries. The vast majority of the total number of projects comes from US companies (72%), and from Japan (12%). Similar figures are found for capital expenditure (73% and 10% of €16.2bn, respectively).

Table 6.4: Where do EU Companies locate R&D investment?



Source: The 2013 EU Industrial R&D Investment Scoreboard, European Commission, JRC/DG RTD.

Table 6.5: From which companies do EU receive FDI in R&D?

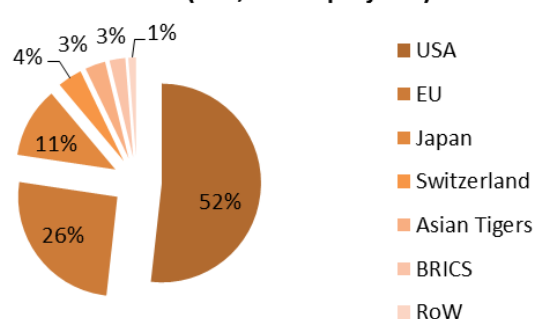


Source: The 2013 EU Industrial R&D Investment Scoreboard, European Commission, JRC/DG RTD.

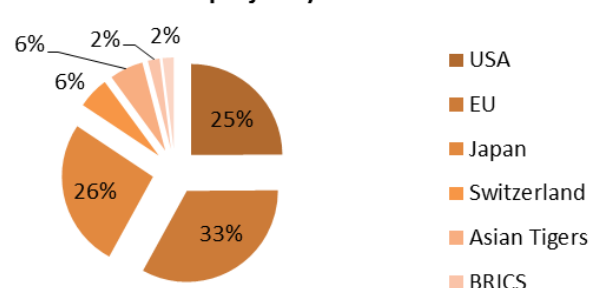
Figure 6.6 compares the inflows and outflows of FDIs in R&D and manufacturing, across geographical areas. The top two pie charts report the percentages of the total number of project outflows, while the bottom pie charts represent the inflows, as a percentage of projects. Comparing R&D inflows and outflows, figures show that the EU has a more balanced account (4% net outflow) than the US (44% net outflow). If we compare the inflow shares of the two types of projects, manufacturing and R&D, we observe that the EU has a larger share of the more knowledge-intensive projects (R&D) than resource-saving investments (manufacturing). Concretely, the difference between these two shares is 7%, larger than for any other world region (BRICS 1%, Asian Tigers 5%, RoW 0%, USA -3%, South Asia -6%, and Latin America -4%).

Figure 6.6: Inflows and outflows of FDIs in R&D and manufacturing by region, 2003-2012

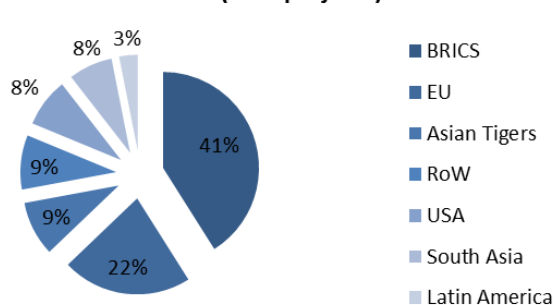
R&D outflows (% 3,345 of projects)



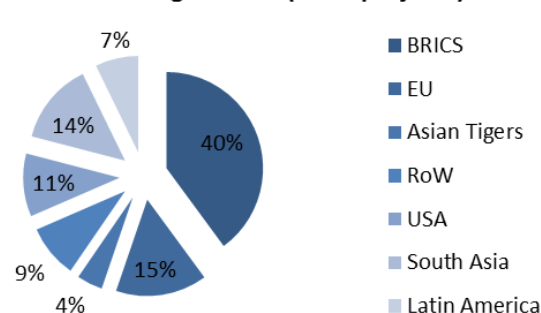
Manufacturing outflows (% 10,514 of projects)



R&D inflows (% of projects)



Manufacturing inflows (% of projects)



Source: The 2013 EU Industrial R&D Investment Scoreboard, European Commission, JRC/DG RTD.

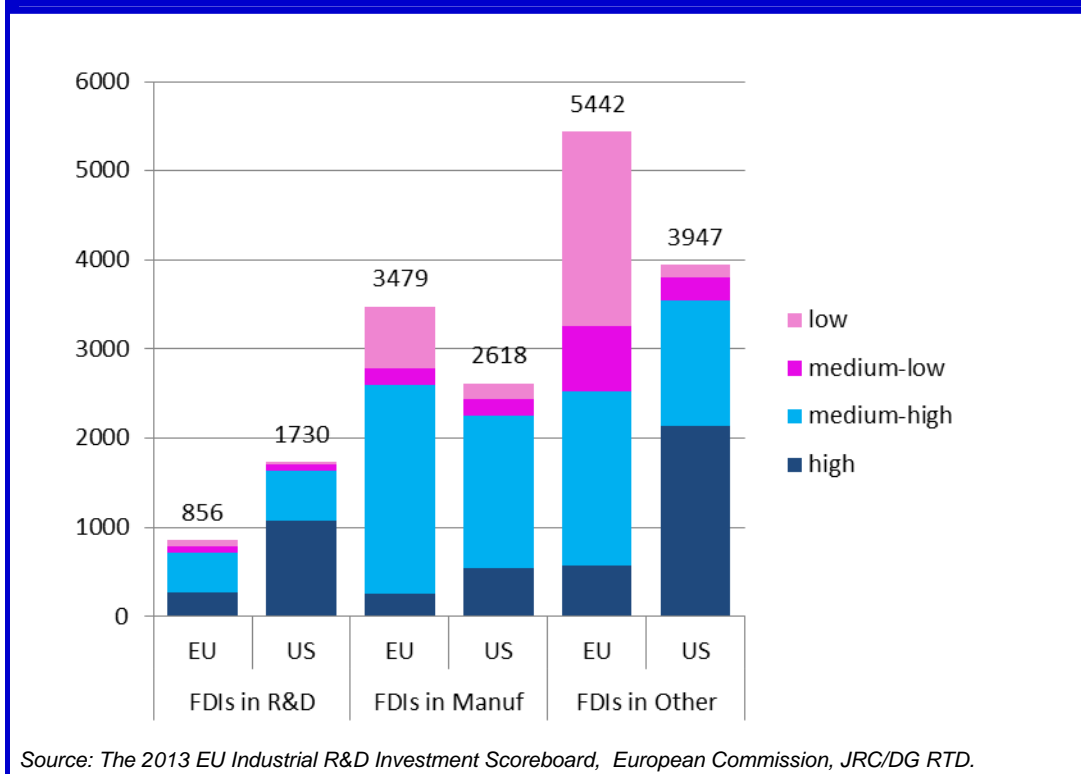
Sector distribution of FDIs in R&D

The identification of the key industrial sectors in which the top R&D spenders of the Scoreboard allocate their investments abroad has been made on the basis of a sample of companies for which data is available for the period 2003-2012.

Figure 6.7 reports the number of projects by type of FDI (R&D versus manufacturing and other types of FDIs¹⁶) and R&D intensity (high, medium-high, medium-low, and low R&D intensity, see Box 1.1). The quasi totality (94%) of FDI projects in R&D from US companies are performed by companies from high and medium-high R&D intensity sectors. This confirms the importance of such investments as drivers for knowledge enhancement. In the EU, this percentage reduces to 83%. EU companies have a larger number of projects in manufacturing compared to the US (nearly 3.5 versus 2.6 thousand). Most of the projects come from companies belonging to medium-high and low R&D intensity sectors (67% and 20%, respectively) for the EU and medium-high and high ones (65% and 21%, respectively) for the US. The other types of FDIs exhibit diverging directions, with the bulk of EU projects originating from medium-low and low R&D-intensive sectors (54%), while the vast majority of US projects (90%) come from companies belonging to high and medium-high ones.

In general, these figures confirm the strategic importance of FDIs for firms operating in more intensive R&D sectors.

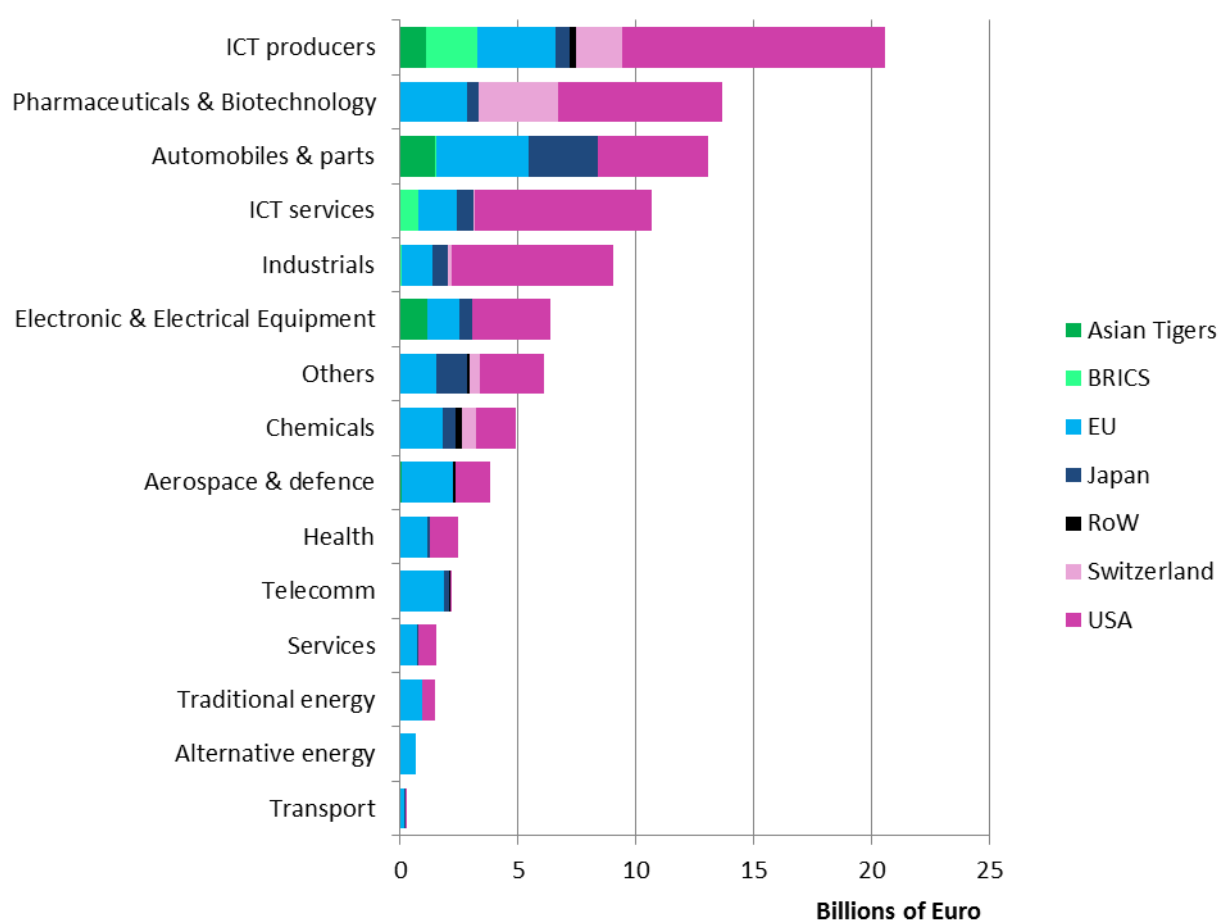
Figure 6.7: Number of FDI projects (2003-2012), by type and sector group.



¹⁶ The other types of FDIs are: sales & marketing, retail, logistics, distribution & transportation, business services, headquarters activities, maintenance & services, ICT & internet infrastructures, education & training, extraction, customer contact, electricity, technical support, shared services, construction, recycling.

Figure 6.8 reports on the industries and regions that originate the highest volumes of FDI capital expenditure in R&D activities. As the graph shows, most of the investments in R&D (60% of the total capital investment of €97.0bn) are concentrated in ICT (production and services), Pharmaceuticals & Biotechnology, and Automobiles & Parts. These results are in line with the findings of another recent study from the European Commission¹⁷, which reports evidence on how foreign innovation-related activities, including R&D are heavily concentrated in terms of sectors.

Figure 6.8 R&D FDI outflows by sector and region, 2003-2012 (€ bn)



Source: The 2013 EU Industrial R&D Investment Scoreboard, European Commission, JRC/DG RTD.

The main actors of this knowledge-seeking type of investment are the US and EU, Japan mainly for the automobiles industry and Switzerland for ICT production and Pharmaceuticals. This suggests that advanced economies are getting access to technological complementary knowledge by investing abroad.

¹⁷ "The role and internationalisation strategies of multinational companies in innovation", 2013 DG ENTR http://ec.europa.eu/enterprise/policies/innovation/files/proinno/innovation-intelligence-study-6_en.pdf

Annex 1 - Background information

The *Scoreboard* is part of the European Commission's monitoring activities to improve the understanding of trends in R&D investment by the private sector and the factors affecting it. It was created in response to the Commission's Research Investment Action Plan¹⁸, which aims to help close the gap between the EU's R&D investment and that of other developed economies.

The annual publication of the *Scoreboard* is intended to raise awareness of the importance of R&D for businesses and to encourage firms to disclose information about their R&D investments and other intangible assets.

The data for the *Scoreboard* are taken from companies' publicly available audited accounts. As in more than 99% of cases these accounts do not include information on the place where R&D is actually performed, the company's whole R&D investment in the *Scoreboard* is attributed to the country in which it has its registered office¹⁹. This should be borne in mind when interpreting the *Scoreboard's* country classifications and analyses.

The *Scoreboard's* approach is, therefore, fundamentally different²⁰ from that of statistical offices or the OECD when preparing Business Enterprise Expenditure on R&D (BERD) data, which are specific to a given territory. The *Scoreboard* data are primarily of interest to those concerned with benchmarking company commitments and performance (e.g. companies, investors and policymakers), while BERD data are primarily used by economists, governments and international organisations interested in the R&D performance of territorial units defined by political boundaries. The two approaches are therefore complementary. The methodological approach of the *Scoreboard*, its scope and limitations are further detailed in Annex 2 below.

Scope and target audience

The *Scoreboard* is a benchmarking tool which provides reliable up-to-date information on R&D investment and other economic and financial data, with a unique EU-focus. The 2000 companies listed in this year's *Scoreboard* account for more than 90%²¹ of worldwide business enterprise expenditure on R&D (BERD). The data in the *Scoreboard* are published as a four-year time-series to allow further trend analyses to be carried out, for instance, to examine links between R&D and business performance.

The *Scoreboard* is aimed at three main audiences.

- **Companies** can use the *Scoreboard* to benchmark their R&D investments and so find where they stand in the EU and in the global industrial R&D landscape. This information could be of value in shaping business or R&D strategy.
- **Investors and financial analysts** can use the *Scoreboard* to assess investment opportunities and risks.

¹⁸ "Investing in research: an action plan for Europe", COM(2003)266, http://europa.eu.int/eur-lex/en/com/cnc/2003/com2003_0226en02.pdf.

¹⁹ The registered office is the company address notified to the official company registry. It is normally the place where a company's books are kept.

²⁰ The *Scoreboard* refers to all R&D financed by a company from its own funds, regardless of where the R&D is performed. BERD refers to all R&D activities performed by businesses within a particular sector and territory, regardless of the location of the business's headquarters, and regardless of the sources of finance. The sources of data also differ: the *Scoreboard* collects data from audited financial accounts and reports whereas BERD typically takes a stratified sample, covering all large companies and a representative sample of smaller companies. Additional differences concern the definition of R&D intensity (BERD uses the percentage of R&D in value added, while the *Scoreboard* considers the R&D/Sales ratio) and the sectoral classification (BERD uses NACE (the European statistical classification of economic sectors), while the *Scoreboard* uses the ICB (the International Classification Benchmark)).

²¹ According to latest Eurostat statistics. However BERD and *Scoreboard* figures are not directly comparable.

- **Policy-makers, government and business organisations** can use R&D investment information as an input to policy formulation or other R&D-related actions.

Furthermore, the *Scoreboard* dataset has been made freely accessible so as to encourage further economic and financial analyses and research by any interested parties.

Annex 2 - Methodological notes

The data for the ranking of the 2013 EU Industrial R&D Scoreboard (the *Scoreboard*) have been collected from companies' annual reports and accounts by [Bureau van Dijk Electronic Publishing GmbH](#) (BvD). The source documents, annual reports & accounts, are public domain documents and so the *Scoreboard* is capable of independent replication. In order to ensure consistency with our previous *Scoreboards*, BvD data for the years prior to 2012 have been checked with the corresponding data of the previous *Scoreboards* adjusted for the corresponding exchange rates of the annual reports.

Main characteristics of the data

The data correspond to companies' latest published accounts, intended to be their 2012 fiscal year accounts, although due to different accounting practices throughout the world, they also include accounts ending on a range of dates between late 2011 and early 2013. Furthermore, the accounts of some companies are publicly available more promptly than others. Therefore, the current set represents a heterogeneous set of timed data.

In order to maximise completeness and avoid double counting, the consolidated group accounts of the ultimate parent company are used. Companies which are subsidiaries of any other company are not listed separately. Where consolidated group accounts of the ultimate parent company are not available, subsidiaries are included.

In case of a demerger, the full history of the continuing entity is included. The history of the demerged company can only go back as far as the date of the demerger to avoid double counting of figures.

In case of an acquisition or merger, pro forma figures for the year of acquisition are used along with pro-forma comparative figures if available.

The R&D investment included in the *Scoreboard* is the cash investment which is funded by the companies themselves. It excludes R&D undertaken under contract for customers such as governments or other companies. It also excludes the companies' share of any associated company or joint venture R&D investment when disclosed. Where part or all of R&D costs have been capitalised, the additions to the appropriate intangible assets are included to calculate the cash investment and any amortisation eliminated.

Companies are allocated to the country of their registered office. In some cases this is different from the operational or R&D headquarters. This means that the results are independent of the actual location of the R&D activity.

Companies are in industry sectors according to the NACE Rev. 2²² and the ICB (Industry Classification Benchmark).

Limitations

²² NACE is the acronym for "Nomenclature statistique des activités économiques dans la Communauté européenne".

The *Scoreboard* relies on disclosure of R&D investment in published annual reports and accounts. Therefore, companies which do not disclose figures for R&D investment or which disclose only figures which are not material enough are not included in the *Scoreboard*. Due to different national accounting standards and disclosure practice, companies of some countries are less likely than others to disclose R&D investment consistently.

In some countries, R&D costs are very often integrated with other operational costs and can therefore not be identified separately. For example, companies from many Southern European countries or the new Member States are under-represented in the *Scoreboard*. On the other side, UK companies are over-represented in the *Scoreboard*.

For listed companies, country representation will improve with IFRS adoption.

The R&D investment disclosed in some companies' accounts follows the US practice of including engineering costs relating to product improvement. Where these engineering costs have been disclosed separately, they have been excluded from the *Scoreboard*. However, the incidence of non-disclosure is uncertain and the impact of this practice is a possible overstatement of some overseas R&D investment figures in comparison with the EU.

Where R&D income can be clearly identified as a result of customer contracts it is deducted from the R&D expense stated in the annual report, so that the R&D investment included in the *Scoreboard* excludes R&D undertaken under contract for customers such as governments or other companies. However, the disclosure practise differs and R&D income from customer contracts cannot always be clearly identified. This means a possible overstatement of some R&D investment figures in the *Scoreboard* for companies with directly R&D related income where this is not disclosed in the annual report.

In implementing the definition of R&D, companies exhibit variability arising from a number of sources: i) different interpretations of the R&D definition. Some companies view a process as an R&D process while other companies may view the same process as an engineering or other process; ii) different companies' information systems for measuring the costs associated with R&D processes; iii) different countries' fiscal treatment of costs.

Interpretation

There are some fundamental aspects of the *Scoreboard* which affect their interpretation.

The focus of the *Scoreboard* on R&D investment as reported in group accounts means that the results can be independent of the location of the R&D activity. The *Scoreboard* indicates the level of R&D funded by companies, not all of which is carried out in the country in which the company is registered. This enables inputs such as R&D and Capex investment to be related to outputs such as Sales, Profit, productivity ratios and market capitalisation.

The data used for the *Scoreboard* are different from data provided by statistical offices, e.g. BERD data. The *Scoreboard* refers to all R&D financed by a particular company from its own funds, regardless of where that R&D activity is performed. BERD refers to all R&D activities performed by businesses within a particular sector and territory, regardless of the location of the business's headquarters, and regardless of the sources of finance.

Further, the *Scoreboard* collects data from audited financial accounts and reports. BERD typically takes a stratified sample, covering all large companies and a representative sample of smaller companies. Additional differences concern the definition of R&D intensity (BERD uses the percentage of value added, while the *Scoreboard* measures it as the R&D/Sales ratio) and the sectoral classification they use (BERD follows NACE, the European statistical

classification of economic sectors, while the *Scoreboard* classifies companies' economic activities according to the ICB classification).

Sudden changes in R&D figures may arise because a change in company accounting standards. For example, the first time adoption of IFRS²³, may lead to information discontinuities due to the different treatment of R&D, i.e. R&D capitalisation criteria are stricter and, where the criteria are met, the amounts must be capitalised.

For many highly diversified companies, the R&D investment disclosed in their accounts relates only to part of their activities, whereas sales and profits are in respect of all their activities. Unless such groups disclose their R&D investment additional to the other information in segmental analyses, it is not possible to relate the R&D more closely to the results of the individual activities which give rise to it. The impact of this is that some statistics for these groups, e.g. R&D as a percentage of sales, are possibly underestimated and so comparisons with non-diversified groups are limited.

At the aggregate level, the growth statistics reflect the growth of the set of companies in the current year set. Companies which may have existed in the base year but which are not represented in the current year set are not part of the *Scoreboard* (a company may continue to be represented in the current year set if it has been acquired by or merged with another).

For companies outside the Euro area, all currency amounts have been translated at the Euro exchange rates ruling at 31 December 2012 as shown in Table A3.1. The exchange rate conversion also applies to the historical data. The result is that over time the *Scoreboard* reflects the domestic currency results of the companies rather than economic estimates of current purchasing parity results. The original domestic currency data can be derived simply by reversing the translations at the rates above. Users can then apply their own preferred current purchasing parity transformation models.

²³ Since 2005, the European Union requires all listed companies in the EU to prepare their consolidated financial statements according to IFRS (International Financial Reporting Standards, see: <http://www.iasb.org/>).

Table A3.1. Euro exchange rates applied to *Scoreboard* data of companies based in different currency areas (as of 31 Dec 2012).

Country	As of 31 Dec 2011	As of 31 Dec 2012
Australia	\$ 1.2740	\$ 1.27
Brazil	2.4051 Brazilian real	2.69 Brazilian real
Canada	\$ 1.3210	\$ 1.31
China	8.1526 Renminbi	8.30 Renminbi
Czech Republic	25.7998 Koruna	25.14 Koruna
Croatia	7.5370 Kuna	7.55 Kuna
Denmark	7.4344 Danish Kronor	7.47 Danish Kronor
Hungary	314.158 Forint	291.54 Forint
India	68.9178 Indian Rupee	72.25 Indian Rupee
Israel	4.9439 Shekel	4.92 Shekel
Japan	100.6036 Yen	114.15 Yen
Mexico	18.10 Mexican Peso	17.16 Mexican Peso
Norway	7.750 Norwegian Kronor	7.35 Norwegian Kronor
Poland	4.4218 Zloty	4.09 Zloty
Russia	41.666 Rouble	40.08 Rouble
South Korea	1492.54 Won	1408.45 Won
Sweden	8.9119 Swedish Kronor	8.58 Swedish Kronor
Switzerland	1.2174 Swiss Franc	1.21 Swiss Franc
Turkey	2.450 Turkish lira	2.35 Turkish lira
UK	£ 0.8368	£ 0.84
USA	\$ 1.2939	\$ 1.32
Taiwan	\$ 39.1696	\$ 38.28

Glossary of definitions

1. **Research and Development (R&D) investment** in the *Scoreboard* is the cash investment funded by the companies themselves. It excludes R&D undertaken under contract for customers such as governments or other companies. It also excludes the companies' share of any associated company or joint venture R&D investment. Being that disclosed in the annual report and accounts, it is subject to the accounting definitions of R&D. For example, a definition is set out in International Accounting Standard (IAS) 38 "Intangible assets" and is

based on the OECD “Frascati” manual. **Research** is defined as original and planned investigation undertaken with the prospect of gaining new scientific or technical knowledge and understanding. Expenditure on research is recognised as an expense when it is incurred. **Development** is the application of research findings or other knowledge to a plan or design for the production of new or substantially improved materials, devices, products, processes, systems or services before the start of commercial production or use. Development costs are capitalised when they meet certain criteria and when it can be demonstrated that the asset will generate probable future economic benefits. Where part or all of R&D costs have been capitalised, the additions to the appropriate intangible assets are included to calculate the cash investment and any amortisation eliminated.

2. **Net sales** follow the usual accounting definition of sales, excluding sales taxes and shares of sales of joint ventures & associates. For banks, sales are defined as the “Total (operating) income” plus any insurance income. For insurance companies, sales are defined as “Gross premiums written” plus any banking income.

3. **R&D intensity** is the ratio between R&D investment and net sales of a given company or group of companies. At the aggregate level, R&D intensity is calculated only by those companies for which data exist for both R&D and net sales in the specified year. The calculation of R&D intensity in the *Scoreboard* is different from than in official statistics, e.g. BERD, where R&D intensity is based on value added instead of net sales.

4. **Operating profit** is calculated as profit (or loss) before taxation, plus net interest cost (or minus net interest income) minus government grants, less gains (or plus losses) arising from the sale/disposal of businesses or fixed assets.

5. **One-year growth** is simple growth over the previous year, expressed as a percentage: $1 \text{ yr growth} = 100 * ((C/B) - 1)$; where C = current year amount, and B = previous year amount. 1yr growth is calculated only if data exist for both the current and previous year. At the aggregate level, 1yr growth is calculated only by aggregating those companies for which data exist for both the current and previous year.

6. **Three-year growth** is the compound annual growth over the previous three years, expressed as a percentage: $3 \text{ yr growth} = 100 * (((C/B)^{(1/t)}) - 1)$; where C = current year amount, B = base year amount (where base year = current year - 3), and t = number of time periods (= 3). 3yr growth is calculated only if data exist for the current and base years. At the aggregate level, 3yr growth is calculated only by aggregating those companies for which data exist for the current and base years.

7. **Capital expenditure (Capex)** is expenditure used by a company to acquire or upgrade physical assets such as equipment, property, industrial buildings. In accounts capital expenditure is added to an asset account (i.e. capitalised), thus increasing the asset's base. It is disclosed in accounts as additions to tangible fixed assets.

8. **Number of employees** is the total consolidated average employees or year end employees if average not stated.

Annex 3 – Composition of the top 1000 EU sample

The analysis of chapter 5 applies an extended sample of 1000 companies based in the EU. It consists of 527 companies included in the world R&D ranking of top 2000 companies and additional 473 companies also ranked by level of R&D investment. The composition by country and industry of the EU 1000 sample is presented in the table A3.1 below.

Table A3.1 Distribution of the sample of 1000 companies based in the EU by country and industry.

Industry			EU country codes																			
(ICB-3D)	AT	BE	CZ	DE	DK	ES	FI	FR	UK	GR	HU	IE	IT	LU	MT	NL	PL	PT	SE	SI	Total	
Aerospace & Defence		1		2		1		6	8				2			1			1		22	
Alternative Energy				4	1									1							6	
Automobiles & Parts	4			20			1	6	11				6						2		50	
Banks		2		6	2	1		1	5			1	2	1		3	1	2	3		30	
Beverages		1		1	1				1							1					5	
Chemicals	1	3		12	1		3	4	11					1		3			3		42	
Construction & Materials	3	5		7	1	3	2	6	1			2	2			3			2	1	38	
Electricity		1	1	1		2	2	2	4				2					1	1		17	
Electronic & Electrical Equip.	3	4		16	2		5	12	18			1	4	1		6			4		76	
Equity Investment Instr.				1																	1	
Financial Services				4				1	6							1			4		16	
Fixed Line Telecommunications	1	1		1	1	1		1	1				1			1	1	1	1		12	
Food & Drug Retailers		1							2							1					4	
Food Producers				2	1		4	3	8			3		1		5					27	
Forestry & Paper							3	1	1										4		9	
Gas, Water & Multi-utilities	1			3	1			2	3												10	
General Industrials		1		10	1	1	1	1	10				1			2			5		33	
General Retailers				4				1	6												11	
Health Care Equipment & Services		2		13	2			2	7			2	1			2			6		37	
Household Goods & Home Const.				5		1	1	2	3				3	1		1			2		19	

Industry	EU country codes																				
(ICB-3D)	AT	BE	CZ	DE	DK	ES	FI	FR	UK	GR	HU	IE	IT	LU	MT	NL	PL	PT	SE	SI	Total
Industrial Engineering	4	2		42	4	3	8	7	14			1	8	2		5			12		112
Industrial Metals & Mining	2	2		5			2	1						2		1			1		16
Industrial Transportation			1	1	1			3	1				2			1			2		12
Leisure Goods				1	2		1		2							1					7
Life Insurance				1				1	2												4
Media								5	7				1						1		14
Mining				1					4										2		7
Mobile Telecommunications				1		1	1		3												6
Nonlife Insurance	1			1					1												3
Oil & Gas Producers	1					1	1	1	3				1								8
Oil Equipment, Services & Distrib.								2						1		3					6
Personal Goods	1			6				4					3	2							16
Pharmaceuticals & Biotechnology	1	4		13	13	4	2	18	29	1	1	4	5			3		1	11	1	111
Real Estate Investment & Services				1				1													2
Software & Computer Services	2			19	2	2	5	21	45				1			4	2	1	7		111
Support Services				10				2	19			1				2			4		38
Technology Hardware & Equip.	2	2		7	1	1	2	6	11	1		1				5			7		46
Tobacco									1										1		2
Travel & Leisure	1			3			1	1	4				1		1				2		14
Total	28	32	2	224	37	22	45	124	252	2	1	16	46	13	1	55	4	6	88	2	1000

Annex 4 - Access to the full dataset

The 2013 *Scoreboard* comprises two data samples:

- The world's top 2000 companies that invested more than €22.6m in R&D in 2012.
- The top 1000 R&D investing companies based in the EU with R&D investment exceeding €5.2m.

For each company the following information is available:

- Company identification (name, country of registration and sector of declared activity according to ICB classifications).
- R&D investment
- Net Sales
- Capital expenditure
- Operating profit or loss
- Total number of employees
- Main company indicators (R&D intensity, Capex intensity, Profitability)
- Growth rates of main indicators over one year and three years.

The following links provide access to the two *Scoreboard* data samples containing the main economic and financial indicators and main statistics over the past four years.

R&D ranking of world top 2000 companies:

<http://iri.jrc.ec.europa.eu/documents/10180/cf102ca1-e554-46d2-b271-1168e83a419c>

R&D ranking of EU top 1000 companies:

<http://iri.jrc.ec.europa.eu/documents/10180/64449b4f-9c6f-41a1-9dcc-73183d84d17b>

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Abstract

This report presents the results of the 2013 "EU Industrial R&D Investment Scoreboard" (the *Scoreboard*). The *Scoreboard* contains economic and financial data for the world's top 2000 companies ranked by their investments in research and development (R&D). The sample consists of 527 companies based in the EU and 1473 companies based elsewhere. An additional sample comprising the top 1000 R&D investing companies based in the EU is included. The *Scoreboard* data are drawn from the latest available companies' accounts, i.e. usually the fiscal year 2012 or 2012/13.

In this *Scoreboard* edition, world top R&D investors show a remarkable resilience of R&D investment growth in a period of economic uncertainty. In 2012, companies continued to increase significantly their R&D investments in a context marked by a slow-down of net sales growth and a decline in operating profits.

Trends observed show a significant variation of R&D investment and economic results across industries and sectors. This reflects persistent market uncertainties, in particular regarding the uneven potential for growth of international markets and the macroeconomic background.

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